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Rhode Island: University of Center for Ocean Management Studies

INFORMATION SYSTEMS FOR COASTAL ZONE MANAGEMENT

Workshop Sponsored by

The Center for Ocean Management Studies

University of Rhode Island

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W. Alton Jones Campus

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PREFACE

On June 22-23, 1978, a workshop on Information Systems for Coastal Zone Management was sponsored by the University of Rhode Island's Center for Ocean Management Studies with partial funding from the Environmental Science Information Center, Environmental Data and Information Services of NOAA, under contract No. 01-8-M01-2959. The workshop was held at the University's W. Alton Jones Campus and included a small group of people with highly diverse backgrounds in information systems, coastal zone management, and data analysis and processing.

The objectives of the workshop were to discuss:

1. The role of existing management systems in coastal resource planning and management.

2. How information systems may be designed or modified to help states meet their legal, technical, and economic goals for coastal zone management.

3. Why certain systems are successful and others fail to meet the planner's needs for information.

4. The extent to which information systems provide interagency/inter-disciplinary cooperation.

5. The potential long-range benefits of information systems.

6. How much, what kind, and in what form is information needed.

The agenda for the two-day workshop was designed to develop an overview of the information systems that presently exist on the local, state, regional and national scale.

In an effort to provide a common framework around which information systems could be discussed, speakers were asked to follow a set of guidelines when presenting their particular system. The guidelines were as follows:

1. Goals and objectives of system
   - Identification of users
   - Determination of data needs

2. Methodology and procedures used

3. Administrative and operational framework

4. Implementation of system

5. Interfacing between information-system-users

6. Problem areas

7. Prospects for the future

The following collection of papers reflect the discussions at the workshop. We hope that they will provide a basis for further discussions on information systems for coastal zone management.

ACKNOWLEDGMENTS

Several people contributed to this effort. First and foremost, a special thanks to Malcolm Spaulding, Peter Cornillon, and Connie Knapp who initiated the idea of a Workshop on Information Systems and served on the planning committee. Charlene Dunn, Robert Freeman, and Cheryl Alexander also provided valuable assistance in planning the program.

Several individuals at the University provided logistical and technical support in organizing the workshop and preparing this volume. Lance Brockmeier edited and summarized contributions from the Workshop participants. Leslie Ames, Elaine Ranone, and Carol Dryfoos typed the papers and handled distribution.

Virginia K. Tippie
Executive Director
Center for Ocean Management Studies

SUMMARY

It is becoming increasingly obvious that as one attempts to manage the coastal environment, the need to understand how the ecosystem, in its broadest terms, functions is a critical component in the decision-making process. Information in the form of environmental, political, sociological, and economic data as well as predictive tools define the basis of our understanding of this complex interacting system. From this information and the skill we show in interpreting and applying it comes the foundation of our decisions. With the trend to employing increasing amounts of this information for decision making, it has become critical to collect, organize, and analyze this information in the most efficient manner.

One of the strongest consensus to be reached at the workshop was that there exists entirely too much useless and irrelevant data. A primary goal of any information system is to tailor the information collected to address a specific, well-defined problem. System developers must keep in mind that the size of the data base does not determine the ultimate worth of the system. It was also stressed that one must assure an interdisciplinary view towards this information-collection effort such that diverse points of view and concerns are adequately addressed.

Another point to emerge was that how information is packaged, handled, and presented to the user-community is critical to its ultimate usefulness. Data that is analyzed and synthesized in a series of well-defined chunks so that it is easily assimilated by people using the system is likely to be used extensively and provide useful input to management decisions. Incremental additions of data and methodologies receive the greatest acceptance by system users. Through this technique, an increasing amount of information can be brought to bear on the decision-making task.

A major problem with many systems is developing system credibility. In other words, developing trust in the information contained in the system as well as how the data is processed and presented. To accomplish this task, it was concluded that the system user should be intimately involved with the development, structure, and implementation of the information system. This interface between system users, system developers, and the information is extremely critical. The failure to demonstrate the accuracy of the data and the assumptions of predictive models and processing techniques has caused many otherwise well-conceived information systems to be abandoned. Additional efforts to alleviate this credibility problem include developing the system so that it educates its user, formulating the input and output of the system in simple, non-"computerese" language, carefully designing the information output to meet the users needs, and housing the system so that the information can be easily accessed.

Although not stated explicitly during the workshop an emerging concern was to assure that information systems are designed to be as cost effective as possible. The design process would include the appropriate selection of system software and hardware and how the system would be integrated into the overall administrative structure of the organization. Flexibility in system growth and maintenance, as well as changes in structure brought on by changing management strategies, were also noted as key elements in maintaining the necessary financial resources for information systems.

Throughout the workshop presentations and discussions, there were a multitude of definitions as to who the system "users" were and what their needs were. For every different system there appeared to be a different target audience. While no general consensus was reached by the workshop participants as to a single definition of the user group, it became clear that the design of each information system was based more on the administrative structure within which the system operated than on any general principles of information transfer.

Probably one of the most difficult tasks in implementing an information system is dealing with the many interfaces between the system developers, system users, and the actual data and processing techniques contained in the system. This general problem of getting a diverse group of people with differing backgrounds and experiences to focus on designing, developing, and implementing a system to access a wide array of data and predictive tools is common to many other areas. The emerging consensus of the workshop participants was that while this is an extremely difficult task, early and continuous involvement of each group in the conceptualization stage of system design and having a clear view as to what the objectives of the system are were the most important considerations. Through this time-honored process of design, construction, and redesign, with each new step undergoing critical interdisciplinary review, allows an information system to be constructed on which rational management decisions can be based.

While the foregoing paragraphs attempt to summarize the general conclusions of the workshop and an idea as to the range of problems addressed, the interaction both in discussion periods and in informal conversations was invaluable in communicating the experiences of the workshop participants in incorporating and working on information systems.

At the end of the two-day period, it was concluded that both the formal and informal exchange of ideas and experiences on coastal information systems, both in their design and use, had been extremely useful. It was suggested that additional workshops with a greater representation from the coastal zone management community be held to address several questions in considerably more detail. It is hoped that planning will soon commence to hold these additional meetings.

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MARINE AND COASTAL INFORMATION NETWORKS

Robert R. Freeman
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The Environmental Data and Information Service is pleased to join with the Center for Ocean Management Studies in sponsoring this Workshop on Information Systems for Coastal Zone Management. The Workshop follows immediately on the heals of the Center's annual conference, which had as its theme the limits to rational decision-making in ocean management. From EDIS's point of view our purpose in holding this workshop is to explore with a diverse group of experts in information systems, coastal management, and natural resource management the problems and possibilities for improving the flow of information on which rational decision-making is based.

Over the past 10 years a variety of new Federal programs have made it possible for, and even required, the states to collect and use information for environmental and natural resource decision-making. Examples include the National Coastal Zone Management Act of 1972, and the National Sea Grant College and Program Act of 1966. Owing to this growing emphasis on interdisciplinary coastal and marine planning and management, and the increasing Federal partnership with the states in working on these problems, there is a demonstrated need for timely, pertinent and easily accessible coastal and environmental information at the state and local levels.

A threefold problem is apparent in attempting to meet the information and data needs of coastal and marine resource planners, managers, and scientists: (1) the lack of any information responsive to some needs, (2) the lack of a well-developed infrastructure for providing convenient availability and easy access to needed information, and (3) the lack of linking mechanisms for synthesizing the diverse types of needed information into a form that can be comprehended and used. Producing new knowledge to fill known deficiencies is the goal of numerous research and development programs such as the National Sea Grant Program. But knowledge only becomes information if it can be delivered when, where, and in the form it is needed.

Delivery System Deficiencies

There are no established networks for information dissemination for coastal resource management activities. This is not to say that information resources do not exist, but generally the required information is scattered and organized to serve other purposes.

For example, the efforts of many Federally-sponsored programs have resulted in problem-oriented collections of published information, data, and graphical presentations which have been utilized largely within the context of research, planning, and policy formulation, within specific states. These information collections exist in very heterogeneous forms, media, and formats. This variability has created many problems even though the usefulness of sharing information on an intra- and inter-regional basis has frequently been acknowledged. Compounding the problem, the Federal Government's vast data and information resources applicable to the interdisciplinary needs of coastal and marine management and planning are often thought of as remote and inaccessible. These conditions indicate the lack of an adequate delivery system.

What is needed is special expertise to maintain an awareness of existing resources, to know how to gain access through efficient search techniques, and to be able to make the information available even though it may be found at a distant location. In short, this means a set of focal points, known to those who need information by frequent contact, and possessing the special skills of the information broker.

<u>Fitting the information to the need</u>

Both the information and the user in marine and coastal resource management differ from the model of the scientific information system. The community is heterogeneous in the extreme and oriented toward public decision-making rather than research.

Marine and coastal resources management requires scientific information and data, but also a variety of land use data, resource information, demographic data, information about on-going activities and programs, and graphic information such as conventional maps and remote sensing and aerial photography. The difficult task is to synthesize this interdisciplinary collage and to package it in a form that effectively meets the needs of the heterogeneous user community.

One Solution: Regional Coastal Information Centers.

In response to this problem, the National Oceanic and Atmospheric Administration (NOAA) is sponsoring the development of Regional Coastal Information Centers (RCIC's). Three components of NOAA ... the Environmental Data and Information Service, Office of Coastal Zone Management, and Office of Sea Grant ... are cooperating in this effort, coordinated by the NOAA Marine Advisory Service (NMAS) program.

Strategically placed in key Sea Grant Programs throughout the coastal states and coordinated at the national level by NMAS, the RCIC's could interface to create a network of specific regional information and data resources available both at the state and local levels and to national institutions. While operating under national guidelines, each Center will acquire the subject specificity of its region and match its services to the particular needs of its users.

Initially the RCIC's efforts are following the more traditional methods of information identification and dissemination. This will enable them to establish a strong base and a close communication with the user community. As the users are identified and basic services are established, each Center will begin to add new services, tailored to meet the expressed needs of their region.

Creating a network.

More is needed to move from a set of isolated regional information centers toward the full use of available national information resources. More sophisticated services will be required which will entail extensive use of computerized systems and will necessitate the development of new mechanisms for handling the interdisciplinary nature of coastal resources planning and management.

Developing a national network of RCIC's within the context of established national and local environmental, land use, and natural resources institutions raises complex questions of network design. Among the problems to be addressed by this project are the following: What is the optimal mix of information resources, products, and services at each level and specifically for the regional level? What communication patterns should be established? What new data bases are required to support the needs of a regional community? What computerized capabilities are required to use the data bases effectively? These questions must be resolved prior to implementation of the network.

The project will examine the feasibility, optimal structure, and potential benefits of an information utility to support a national network of regional coastal and marine resource information centers. The information utility concept as applied to these regional centers is based on the notion that powerful information technologies of significant potential benefit to natural resource managers and scientists are available for use if economies of scale can be achieved through a resource-sharing network.

None of the proposed regional centers alone would be large enough to command the availability of the technology, but together it may be feasible.

Specifically, the project will investigate and suggest a design for a system that would provide access to each of the regional centers, through computer terminals and telecommunication facilities, the capabilities of

+ a data base management and information retrieval package
+ a text-editing system (e.g., ATS or WYLBUR)
+ a computer conferencing or electronic message switching system
+ simulation and gaming packages appropriate to natural resource planning

Each of these technologies is already developed. To various extents, each has been tested within a network context. Consequently, it is primarily the linking of the four and their application to the particular needs of coastal and marine resource planning that requires testing.

The impact of a successful outcome would be to add considerably to the national capability for rational natural resource decision-making. In most parts of the United States, the resources for marshalling and analyzing data and information for planning are spread so thin that much valuable information goes to waste through lack of proper dissemination.

Placing the data processing power of a computer utility of the type suggested in the hands of this community will amplify the capabilities of each member.

Systems: Issues and Problems

The major problem in existing information systems is ineffective interfacing between the system and the users. Frequently systems have been developed before the user was consulted as to how the information was to be used. This has resulted in an information packaging problem - the system produces the data but not in a form that the user can utilize. On the other hand, system developers often are requested to provide a system before the user is correctly identified. For example, systems developed for planners have often been utilized primarily by political decision-makers.

Additional related problems discussed in the papers include the following:

- The user group often becomes too sharply defined when in fact the information should be utilized by a broad range of users;

- Due to a language barrier inappropriate formatting can develop requiring an interpretive step between the system and the user;

- Due to the inability of a system to readily answer the users' needs, the users' required information is camouflaged in worthless data;

- Systems are often not used effectively. Users do not understand the system.

Many of these problems can be obviated through better planning and earlier user participation.

TRANSCRIPT OF
REMARKS DELIVERED BY

DONALD B. STRAUS

AT

INFORMATION SYSTEMS WORKSHOP
June 22, 1978

First: what is the American Arbitration Association? It is a non-profit corporation approximately 60 years old. Our mission is to settle disputes, not only through arbitration but by a number of techniques including: running conferences, bringing the parties together, various forms of mediation, and many others. I will not, in spite of the name of my organization, be talking today about arbitration which is the role of a third party picked by the parties to make a decision for them. Arbitration is not applicable, at least at the present time, to environmental disputes and I am sure all of you would agree with that.

The theme of our conference is the handling and use of data, and my assignment is the resolution of disputes. Let me start by suggesting that, from the viewpoint of a mediator, it is just as bad to have too much data as to have too little. In environmental mediation, complexity is one of the greatest difficulties with which we have to contend, and an over-load of data adds greatly to complexity.

Based upon my limited experience and also from what I have already heard thus far in this conference, there seems to be a tendency to spend both money and time in gathering data before the nature of the problem is fully understood and, as a corallory use to which the data will be put is clearly defined. It would also appear that, in many of our coastal zone management programs, data is gathered before anything else is attempted. Perhaps it would be useful to reverse both the order and the emphasis in the following way: Place first priority of time and money on trying to identify the issues and the participants who will be concerned with the solution, and then get the participants involved in deciding what data needs to be gathered and to what use it will be put.

Of course, I am not referring here to base-line data which will have general use for all decisions that can be anticipated. I am referring to data that may be needed for resolving a particular issue.

It seems to me that based on what I have heard this morming, that those of you who are in the computer and data game have long since learned how to gather, store, and model data. All this seems to be technically possible, and can be done in many forms with the output appearing in many ingenious ways of display graphics, tables, and text. What is difficult, or seems to me, is this very complex data capability in making decisions and solving problems.

As somebody who came out of a background of labor mediation, I am used to handling data. But usually it is data for two clearly defined parties: a management and a union. And compared to the data banks that have been described here, labor relations data are extremely simple compared to what you are confronting. Furthermore, the outcomes of wrong decisions usually last not more than one or two years and are not catastrophic, whereas what you are dealing with can be catastrophic.

Therefore, clearly those of us from the mediation fraternity who are newcomers to this field need to find new tools for the handling and use of this data overload. Notebooks, slide rules (and believe it or not, I grew up in an era where slide rules were used), file cabinets: this was the "technology" that I grew up with. Today it is obsolete and inadequate, if unassisted, in dealing with data in large environmental issues. So those of us who are in the software part of this have to learn how to interrelate, identify, communicate, and use the more sophisticated tools which are being fashioned by those of you around this table.

This morning I seemed to hear general agreement that "Yes" you do have to identify the users as soon as possible. I think I heard, but maybe this is my own prejudice in wanting to hear, that you also agree that you have to get the users to participate in deciding what data will be useful and in what form it should be. I am sure I heard all of you agree that before you use the data or even start to model it, you have to define what the problems are. Nor can your definition satisfy only you - the data experts, nor even just the planners, you have to get some general agreement of all the major participants that the data will help resolve the previously identified issues. Only then do you start to gather the data. When possible, you get it from data banks that already exist, compiling additional data with original research only to fill the gaps. And finally, it seems to me we have to keep the participants working together as a team, seeking consensus on using the same body of data rather than having each party split off to work with their own data, building their own models, and entering into what I have called "the battle of the printout" with competing computers and models pitted against each other rather than using this powerful tool to solve the problem.

Now, if these are indeed desirable objectives, then mediation skills can be helpful in accomplishing them: skills in listening to what people say, trying to phrase what they say to each other in ways that will be understandable to those who are their opponents, trying to fashion meetings so that they will be productive rather than counterproductive, assisting in communication, and suggesting alternative solutions for getting around an impasse. We heard, for example, that maybe the regulatory agency should not be the place for keeping and issuing data, that perhaps it should be housed in a neutral place. Clearly the American Arbitration Association is not a data housing facility but we have had some experience in being able to mediate disputes over data and, through joint participation, giving the data the stamp of acceptability and credibility. Even data that originates from a source as "suspicious" as a regulatory agency can be made acceptable through such procedures.

We don't need much data to grasp the notion, for example, that drilling for offshore oil will have an almost infinite number of identifiable impacts, some good and some bad, unless, however, we can understand all of the impacts, or at least the major ones, our opinion will be based upon those impacts that support our first impression, or prejudice about the issue. But the verbal means of communicating these impacts, and that is really the way people do communicate, is capable of describing them in bundles of only a few at a time. We simply cannot verbally communicate everything at once that you can put into a computer and have it understandable. We have to think in terms of human bundles of information.

We need to find a way to increase our ability to consider a large number of variables with a large number of participants and still retain the human quality of interpersonal verbal interaction that is the basic way we humans go about solving problems and settling disputes. In our search thus far, we have developed just two very simple methods for doing this.

One we have called "data mediation" which simply means trying to identify who will be the participants in a particular issue to be resolved, and then persuading them to agree on some general groundrules for validating the data that they will use.

The other method, and thus far we have not yet been successful in doing this in any large scale situation, although we have in some small scale situations, is to get the parties to agree to use the same model and therefore avoid what we call the "battle of the printout". Once again, ground rules are needed to govern who should have access to the information and when, how you safeguard what is considered either proprietary information or secret information and still have access to the information necessary for a decision.

Even if you can get agreement on the data and on a model, there remains the even more difficult task of extracting what we have called "human sized chunks" of information, getting them discussed in some reasonable way, getting some consensus on the sub-issues to which they pertain, and then feeding back into the model the sub-agreements that have been reached so that they will have the agreed-upon impact on the total model.

While trying to wrestle with these problems, I asked five questions of George Miller, a distinguished professor of psychology at Rockefeller University. Some years ago, Dr. Miller wrote an absolutely charming, small essay titled, "The Magic Number of 7 Plus or Minus 2". Part of his message was that the normal human being can handle seven variables at the same time. If he is a genius he can handle nine and if he is an idiot he can handle five. The only difference between a genius and an idiot, according to this particular research, was whether you can handle five or nine variables.

I asked Dr. Miller the following questions: 1) "What do we now know about the working of the mind which will help us feed data into a computer and model the computer in a way which would be compatable with helping our mind function better? I suppose another way of asking the same question

would be this: How would our mind work if our capability for intergrating information were 15 plus of minus 2 or even some higher number?
2) "Are there more constructive ways for retrieving information from the computer so that it will better conform with our 7 plus or minus 2 capability?"
3) "Assuming that there are some answers to the above two questions, how can we then feed back into the computer the sub-decisions reached in a way that will influence the model as they would our mind if we had more capability for simultaneous consideration of larger bundles of information?"
4) "If individuals with different interests and values were to participate in decision-making using a common computer model and negotiating over human-sized questions with rapidly available 7 plus or minus 2 bundles of information, would this help the process by producing more rapid consent and more rational decisions, or would it hurt the process? By rational decisions I guess I mean decisions based on all of the available information and an examination of all of the possible solutions." (Now, parenthetically, I have been told by many who are self-styled practical men; don't be silly, rational decisions are not the way these things are done. They are done by emotional feelings, by political considerations, by short-run considerations and by interpersonal cronyism. I understand that, but I also think that unless those of us around this table try to make the process a little but more rational, what the hell are we doing here? I am not a bloody optimist but it seems to me this is what we are about, and anyway, it is fun trying!)
5) "What can we teach mediators about the human mind so that they can make the best use of a computer program with a 7 plus or minus 2 capability?"

Another question I might have asked, but didn't is this: "How can the computer be used to help move citizen decision making from binery votes on entire issues to incremental binery votes on step-by-step movement toward a consensus decisions?"

Now let me explain what I mean by that last question by referring to the recent "Proposition 13" referendum in California. In my view, it is making a mockery of citizen participation to ask voters whether or not they approve of drilling for offshore oil, or whether they want to allow builders to muck up a wetland. Because these are binery decisions that can be made only after a long process of study and deliberation, with sub-decisions leading to a final decision. If we are truly talking about citizen participation, it seems to me we have to break down decision-making, just as I have suggested we have to break down the mass of data into "human sized" chunks. If citizens are to participate, they must be helped to move toward a decision in incremental steps if they are to understand what they are voting for. The computer can help us do this. The only reasons we cling to a simple "yes-no" vote on complicated issues is tradition. The only voting "tools" available to our founding fathers were a piece of paper, a pencil, and some people to count the ballots. You couldn't, in those days, nor did you need to, go into all of the little steps toward a big decision. You prefer Jefferson or Burr? You want to throw the tea from England into Boston Harbor? These were relatively simple questions which could be asked on a binery basis and if the ballots became more complicated you couldn't handle them anyway. With the aid of computers and with modern communications, if we are serious about citizen participation, we could admit the public into incremental decision-making rather than present the voter with a single vote at the end of the process.

Here is the answer I got back from Dr. Miller: "It is true (I believe) that people deal with information overload by organizing it hierarchically. The research in the "7±2" paper was too specialized to justify such a broad conclusion, but it has considerable plausibility on other grounds. The trick, however, is to construct viable chunks. The dimension of the problem that your questions did not explore is what, in addition to how much, should go into a chunk. In other words, not how much should be in it but what it should be.

I believe that there is a structure to most complex problems. I don't see how we could cope with 100 variables simultaneously unless we could decompose them into groups of variables that interact tightly with one another and loosely with everything else. Herb Simon once wrote a little book "The Sciences of the Artificial" in which the moral was that it is much easier to solve ten 10-variable problems than one 100-variable problem.

So a basic question is how to identify the parts that can be resolved more or less independently. Here is one way to think about it. Make a list of all the things that could go wrong (it always seems easier to think of what could go wrong than of what would be right), and then use it to construct a matrix, with one cell per pair of problems. Go through the matrix one row at a time, asking yourself at each column, "If this went wrong, would it have any obvious implications for that?" If so, put a mark; if not, leave it blank.

When you have filled out the matrix, give it to a computer to search for clusters of problems that interact with one another. If you are lucky, the overall problem will resolve into five or six smaller problems that you can deal with independently. This should dictate the first level of chunking. Then take each problem and repeat the whole procedure to analyze it, continuing until you have reached your own mental atoms and can't go any further."

Now to conclude. My colleagues and I at the American Arbitration Association believe that we could add an important new capability to our mediation skills if we could learn how to use the computer's varied capabilities of handling a large volume of data, and of increasing the speed and accuracy of testing a large number of alternative solutions. But before we can do this, we must learn a number of things, among them the following:

- To steer between a fear and distrust of the computer and a simple-minded faith that it can do everything.

- To communicate our needs and knowledge as practitioners of the human art of agreement-making to the programmers and designers of computer data banks and models.

- To extract from the computer human-sized chunks of information that will aid in reaching a consensus on sub-issues.

- To feed back into the computer consensus reached on sub-issues in a way that will have the agreed-upon impacts on the total model.

- To assist parties to play a game of "what if" with the computer model in a way that will give them a synthetic but realistic "experience" of the consequences and different proposals and solutions.

- To develop ground rules for access to the computer rules that will preserve confidentiality of queries passed by each participant, that will not be too costly, and that will provide the desired information in a form that can be understood by the users.

Several different approaches may be used to discuss the user needs. The traditional three-sector approach (public, private and research) will not be used here, since considerable overlap exists among the three. Thus, similarities exist among the objectives of the private sector which, in some instances, parallel those of the public sector, while the procedures and objectives of the research community often correlate with those of both the public and private sectors.

While the end users may use and interpret environmental information differently, it is assumed that all are attempting to maximize the utility of the available environmental resources (basic research being the possible exception). This goal may be accomplished on several different levels, each of which is likely to have a unique informational requirement. The manager's demand for data and information differs from the needs of the policy maker, even when the concern covers the same resource.[1] A simplified conceptual flow diagram of the resource conversion process is depicted in Fig. 1. The lines describing the relationships among environmental agents (planners, managers and policy makers) in the environmental resource conversion process

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[1]In this context, it should be recognized that the division among the end users expressed in this paper may not be clearly defined. Thus, resource managers may on occasion engage in both basic and applied research in addition to formulating policy, while planners may on occasion act in the context of policy makers. The distinctions in this paper are made for the purpose of discussing the nature of the informational demand. In reality, the distinctions are considerably blurred.

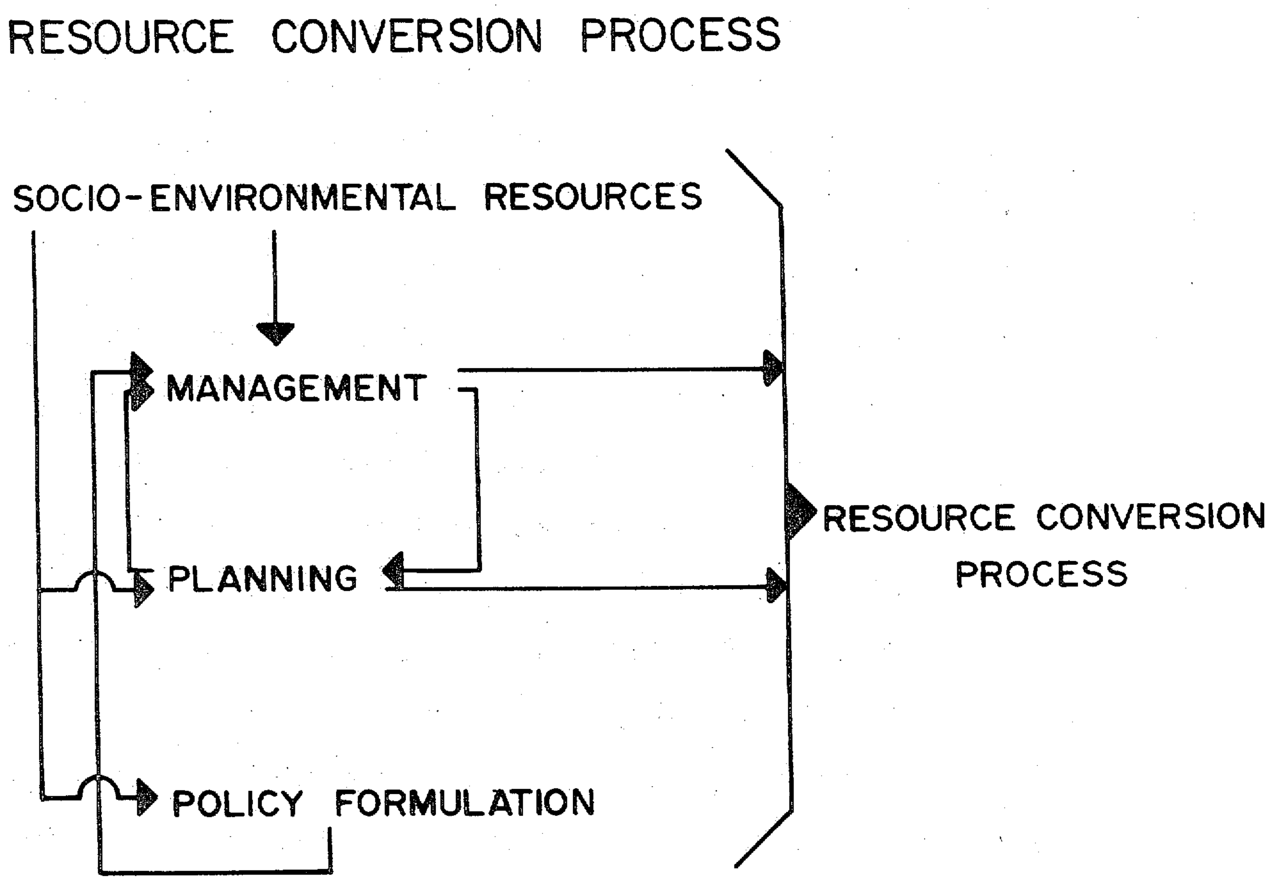
RESOURCE CONVERSION PROCESS
SOCIO-ENVIRONMENTAL RESOURCES
MANAGEMENT
PLANNING
POLICY FORMULATION
RESOURCE CONVERSION PROCESS

Fig. 1

illustrate the case of the idealized informational demand.[1]

The socio-environmental resources are highly dynamic, comprising the sum total of past interactions between the physical environment and the natural and social forces acting upon it. No attempt has been made to segregate the physical (natural) from the social environment.

To plan or modify the physical environment without taking into consideration the social and economic forces acting upon it is likely to result in environmental decisions which are less efficient than would otherwise be the case. By the same token, to discuss social change without taking into consideration the physical environment is likely to lead to inefficient plans from a social, economic, and environmental point of view. The resource conversion process contains four different components: (a) research, (b) planning, (c) management, and (d) use. Two additional comments need to be made. First, the four components are found in activities under the jurisdiction of both public and private sectors. Secondly, while one or more of the individual components may be relatively more important during the various stages of the project, each will eventually occupy a relatively stable niche in the functional hierarchy in the resource conversion process. In

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[1] By resource conversion process is meant any use of the environment, whether used in an active or passive mode. Fishing and sightseeing are examples of resource conversion processes. Both involve the use, and in some sense the consumption of the environment. Both processes require data describing the physical and social processes involved in the resource conversion process.

The types of variables required by the end users in the past have been limited to either physical or social parameters. Considerable scientific research is still limited to either of these categories; an increasing amount of applied research involved with environmental planning and policy formulation includes both physical and social variables. Consequently, it is clear that the ideal DIS would have to consider parameters within both the social and physical variable set.

The importance of the temporal dimension has long been recognized, particularly in those areas involved with straight line time projections. While numerous base line studies have been done involving social and physical parameters, the value of continuous and regularly collected socio-environmental variables is indispensible to predictive studies when time series are the only information incorporated in the predictive model.

The last dimension is probably the least understood and concerns the geographical location and spatial processes which have been identified by major users. Spatial (environmental) data can be categorized into three major groups: point, linear and areal. Each of these may be analyzed according to its distributional characteristics, of which three are generally recognized (clustered, even, and regular). These distinctions are important from an environmental data design point of view, since the user objective may call for specific sampling techniques. These requirements may not be satisfied unless the technical design of the system is sufficiently flexible to other words, research and planning may be relatively more important during certain stages--usually the earlier one--of the resource conversion process, although their relative importance may decline later in the process.

Each of the components is identified in Fig. 1. As depicted, the resource conversion process may be initiated by any of the three sectors. In an unregulated situation, the process may begin as a result of the problem coming to the attention of the manager/operator. The demand for date and information may require both socio and environmental information, but it generally covers a relatively smaller geographical area. In the common case, questions requiring information may be initiated within the research sector, among the general public, or as a result of work conducted within the planning sector. Some of these questions may be required to reduce or eliminate environmental conflicts, while in other instances an environmental policy may be formulated in anticipation of such conflicts. Policy and management directives may be geographically open-ended dictated under the National Environmental Policy Act (NEPA, 1971) or may be limited geographically to the passing of local zoning ordinances governing the specific use of a community's beaches. A policy statement may be based on information which has been developed as a result of specific research conducted in the area by public or private researchers, or planners, or may be problems identified coincidentally by managers directly involved in the resource conversion process.

incorporate random and systematic sampling procedures which take into consideration the aforementioned distributional patterns.

An attempt has been made to graphically illustrate the relationships between information users and the informational constraints imposed by costs and frequency of sampling. The functional user classes have been identified on the y axis (Fig. 2); the individual variables segregated into social and physical on the x^1 axis. The temporal dimension is depicted on the z axis, such that the present is framed by the box separating the future from the immediate past. These are depicted as extending towards the lower left portion of the diagram. The data collected in the past (historical information) has been extended towards the upper right of Fig. 2. Strictly speaking, the diagram is "dynamic" in the sense that the present frame is immediately replaced by part of the immediate future, which immediately becomes part of the historical data set. Attempts to illustrate the spatial constraints appear on both the x and y^1 axis. The former shows the two through "n" dimensional pattern, while the y^1 axis depicts the clustered through random continuum.

The preceding discussion is simply a brief attempt to organize environmental information which takes into consideration the specific requirements of the user. There are two additional considerations which are likely to significantly influence the informational system. One is related to the need to make predictive statements; in this case either linear, temporal or multivariate models are required. The informational need must

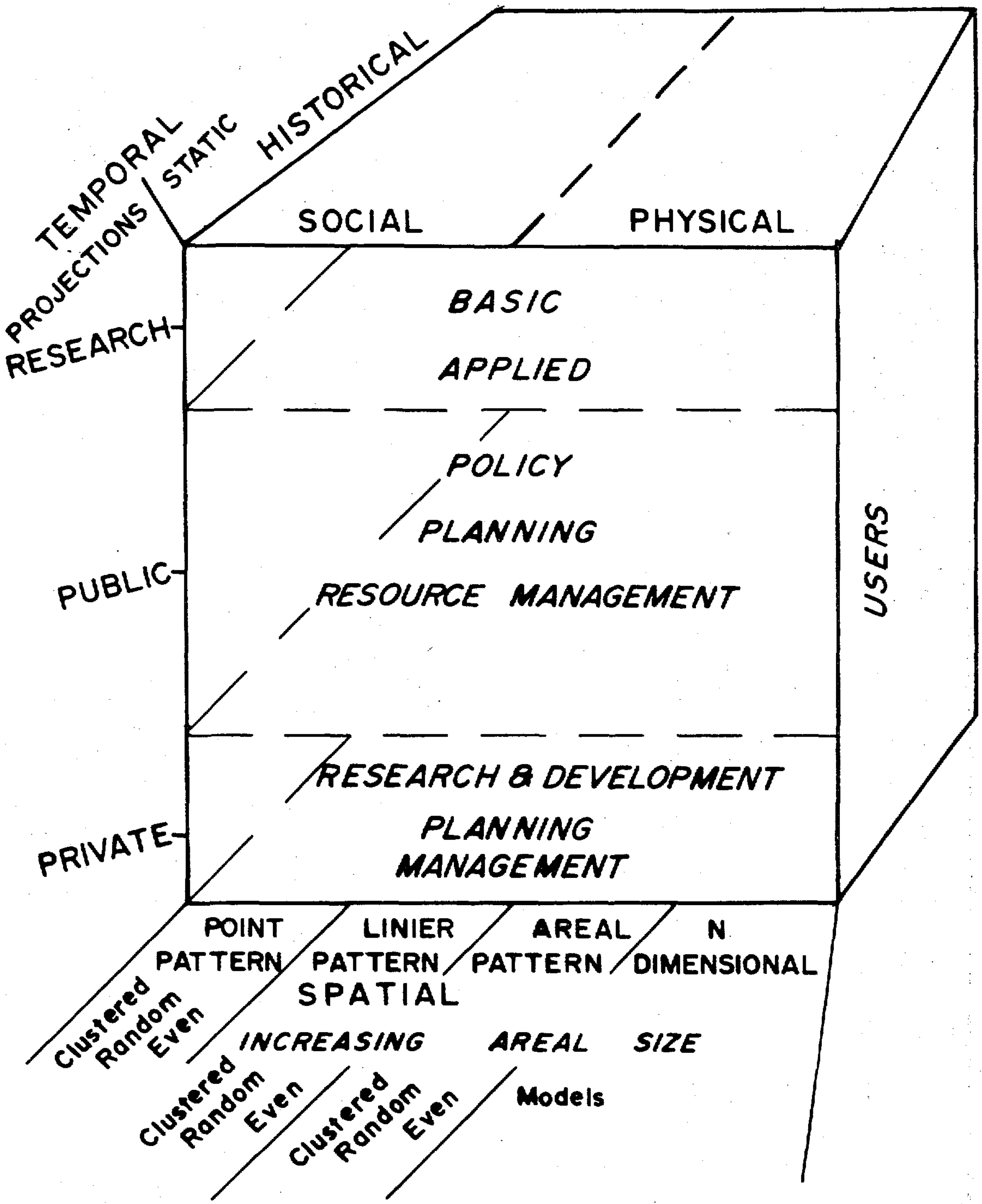
TEMPORAL
PROJECTIONS
STATIC
HISTORICAL
SOCIAL
PHYSICAL
RESEARCH
BASIC
APPLIED
PUBLIC
POLICY
PLANNING
RESOURCE MANAGEMENT
USERS
PRIVATE
RESEARCH & DEVELOPMENT
PLANNING
MANAGEMENT
POINT PATTERN
LINIER PATTERN
AREAL PATTERN
N DIMENSIONAL
SPATIAL
INCREASING AREAL SIZE
Clustered
Random
Even
Clustered
Random
Even
Clustered
Random
Even
Models

Fig. 2

be based on historical information concerning the specific characteristic or several variables hypothesized to be functionally related to the dependent variable. The second consideration concerns the different functional needs of the several sub-users, or more specifically, the objective goals of these user groups.

The environmental decision making process is hierarchical in the sense that the information required to make the decision usually moves from very detailed information, which provides answers to very specific questions, to an ordinal ranking of the decision alternatives. Since the policy maker is apt to make decisions on the basis of ordinal information, it is clear that much of the specific information collected on lower levels of the environmental decision hierarchy is lost. Consequently, the specific technical requirements of the DIS identified on the various axes in Fig. 2 are much less crucial for the policy maker.

Environmental conflicts may be identified by planners, resource managers--and one might include environmental arbiters in this category, most of whom will operate in a context where information is more detailed than that required by the policy maker, but still coarser than that of the researcher directly involved in identifying and isolating specific environmental problem areas. The informational requirements, in terms of area coverage, frequency of collection, and the number and types of variables collected, obviously affect the cost of environmental surveillance as well as the quality of the individual reports. Considering the fragile nature of the coastal zone and nearshore marine environment, and present and future social impacts on this environment, it is obvious that some extremely hard choices will have to be made concerning the development of a suitable DIS.

From the foregoing, it is clear that the DIS requirements differ between the research community (particularly the basic researchers), the planners, and policy makers. Since the demand for data by basic researchers is much more directed and specific, it is unlikely that any comprehensive system can be devised to serve the needs of most environmental researchers. While the utility of a comprehensive DIS for this sector may be marginal, it is clear that the findings developed by the basic researchers are of utmost importance to policy makers and planners.

This constraint is not present in determining the need for a comprehensive coastal management and planning DIS. At least two considerations are important in this context. The first relates to the need for a continuous surveillance of the environmental parameters. The second concerns the geographical coverage, type of sampling or informational network, and the variables considered most important in surveying the social and environmental characteristics.

The sampling frequency may vary from one brief survey to virtually a continuous record of specific variables. The information collected by the Interstate Sanitation Commission (a federally sanctioned water pollution compact operating in the New York-New Jersey Metropolitan Estuary) has divided its efforts in this manner. A portion of the surveillance budget is spent on short-term intensive data collection efforts in specific stretches of the estuary, usually for a one or two-week period. The specific water body may not be re-surveyed for years. Other parts of this agency's surveillance budget is spent on a small number of automatic monitoring stations which have been strategically located in the estuary and which measure between six and ten physical environmental variables every ten to twenty minutes.

There are obviously serious problems with both approaches. This and other agencies have rarely surveyed the user needs for those parameters which may have some significance to the users or the physical environment. While it is difficult to specify a sampling frequency which would serve all users equally well, it is clear that most information must be collected more frequently than every ten years, as has been the case with population and housing information collected by U.S.B.O.C. What is important to remember is that the purpose of this information is to (a) monitor existing resource conversion operations in the coastal and marine environment, and (b) to provide the planners with sufficient information to upgrade existing plans and enable new alternatives to be developed.

The sampling program and a real coverage ought to be flexible enough to incorporate existing ongoing efforts by both the public and private sectors. As previously suggested, such a system should be able to handle interval (field) data, as well as information summarizing studies covering points, linear, and areal patterns. By devising such a system, it would be possible to incorporate the massive data files developed by the U.S.B.O.C. covering both business and social information. In such a system, it should be possible to incorporate summary information as well, as long as the findings are defined geographically. Such non-parametric information would be of particular value to the policy maker, and would have the added attribute of being incorporated into an overall socio-environmental master file.

The last consideration which should be touched upon is related to costs. It is obvious that any changes in existing environmental surveillance are likely to result in increased costs. Such increases have represented a fraction of the increased benefits which an efficient data system is likely to generate.

Because of the very specific and often intensive data requirements of the research community, most of this information is not likely to be of universal value and should not be directly incorporated into the system. While this recommendation may appear contrary to past data system proposals, there appears to be some very persuasive reasons for leaving these data sets out. The U.S.D.O.I. STORET system is an example of an effort to develop a data system from governments and research institutions. While the list of parameters included in the system is impressive, this data is of only limited value as few efforts have been made to verify the validity and laboratory procedures used for each of the data sets incorporated into STORET. A more rational approach from the point of view of research, planning and policy making would be to develop a reference system to enable the users to locate the findings and conclusions from scientific research. It is recognized, of course, that several library search programs have been developed during the past couple of years, and more are being added yearly, however, most of these are not spatially referenced by any of the standard coordinate systems commonly in use.

The proposed geographical sampling system can be considerably coarser than that required by most researchers, thus, considerable savings may be obtained if a coastal and marine environmental DIS is developed with planners, managers, and policy makers as the principal users. The DIS should have the capability of locating both regular and irregularly spaced polygons to accommodate unique spatial distributions. Finally, the system should have the internal capability of integrating multivariate sets to produce integrative map overlays and to model specific socioenvironmental changes over space and through time, besides being able to project such changes into the future.

While these suggestions may appear to be a tall order for an activity which is still in its infancy, this paper has been written in an attempt to formulate the need for a DIS as perceived by a broad spectrum of environmental users. Such a system should not be shaped by mere technical capability, but rather by the needs of the end users.

UVAIS - The University of Virginia Coastal Information System: A Data and Model Index Designed for the Office of Naval Research, Geography Programs

Cary Rea

1. System Design - Data Management

At the University of Virginia, we are designing and implementing a data referral system for coastal data sets. The University of Virginia Information System (UVAIS) provides maximum accessibility to the relevant data sets. Because the inventory contains references to data sources within a restricted operational area - the coast - it is possible for trained technicians to evaluate the sources and tailor the referral entries so that little extraneous information is produced by a query. Primarily for this reason, the system is superior to the big multipurpose data access systems with diverse goals. The referral system provides two types of services: a data inventory and a file of geophysical models.

Computerization of the coastal information system is essential for efficient storage, retrieval, and update of the large volume of material involved. We are using a Navy system called Ship Analysis and Retrieval Program (SHARP) which is a generalized data base management system developed at Naval Ship Research and Development Center (NSRDC), Carderock, Maryland. SHARP allows on-line and off-line access to data bases. Nontechnical persons can easily define, build, maintain, and interrogate their own data bases using a user oriented English like language for retrieval and report generation. This language is highly suited to interactive use from remote terminals. Variable length records and multiple record types are allowed within a single file. Finally, coded input data can be translated to plain language on output, and tutorial retrieval programs can be written for use by persons who have no knowledge of the system.

A tutorial search mode was programmed specifically for UVAIS, providing an easy means of access to the UVAIS system for the new or inexperienced user. It allows formation of a question based on geographic location, environmental variables, and data collection program status. Users of the tutorial feature are given the option of receiving an information section. This service provides background information for users who are not familiar with the literature and data collection methods of a particular parameter. The information sections also refer the user to recognized experts in the field and to other data indices which contain coastal information.

2. System Design: Inventory

The UVAIS coastal inventory considers only physical, geologic, and meteorologic coastal variables. For the purposes of this project, nearshore (transformation zone) and beach variables are most significant; some offshore observations, however, such as waves, must be included. Measurements within small bays, sounds, and estuaries have been given a lower priority.

Primary variables are those generally recognized by coastal investigators to be of major importance in determining the nature of the coastal environment, including dynamics. These include driving forces (wind, waves, tides, and currents), and those geological/morphological factors (bathymetry, shore and bottom geology) that determine the reaction of the coastline to the driving forces. All other variables are classed as secondary. Data records are also classed as primary or secondary depending on the parameters measured. However, any record can be placed in a third category (complementary) if the length or quality of the data recorded is such that it would be of little value for prediction purposes by itself but could be used as a complement to a longer or higher quality record of the same variable at the same or a nearby location.

Variables and records in UVAIS are also classified as real and synthetic. A real variable/record refers to an actual measurement of a physical variable. A synthetic variable/record represents an estimate, using a data generating scheme, of a measurement similar to those classed as real. There are also derived variables/records which are obtained by manipulation of real or synthetic data. These are reported in UVAIS only if the derivation is unique, costly or time consuming, or if the data required to perform the derivation are not available through our system. For example, three-day means of wave height are not included, because the original data are available and the manipulation required is trivial. On the other hand, storm track data are included, because they are derived from pressure observations at many stations, not all of which are included in the UVAIS.

Sources of data are entered into the data inventory in two forms: 1) general study information, with one record per study, which includes information such as the name of the principal investigator, the cost of obtaining the data, and a list of publications; and 2) site specific records containing detailed information about the location of each data collection site, the variables measured, methods used, and dates of operation.

3. System Design: Geophysical Model File

A user of the data inventory will not always locate a suitable data set; however there may be other types of data available which could be run through a model to get the desired result. Therefore we have produced a prototype model inventory file to be used in conjuntion with the data inventory.

Since the business of science is primarily the design and testing of models, clear quidelines were necessary to avoid encompassing in UVAIS the entire body of scientific thought.

We have therefore chosen the following criteria for selection of geophysical models: conceptual and physical models are excluded, but models of the numerical, mathematical and simulation varieties will be included in our system. Many mathematical models exist only in published form as sets of equations. This type of model (the bulk of the available source material) is in general to be excluded from our system. We are left with numerical, simulation, and some mathematical models, along with hybrids of these types, which depend on digital (or perhaps analog) computing equipment to produce synthetic data of the same type as the data stored in the UVAIS inventory Simple models using graphical or tabular methods (such as the SMB hindcast model) are also to be included.

A further requirement for the inclusion of models in our file is that they be readily available in usable form. Many models exist for which there is little or no documentation, and which are useless except in the hands of the designer. Models of this type can be included in the system, but an appropriate notation is required.

Models are described in a third record type within UVAIS. Model records contain most of the same information found in the general study records of the data inventory plus additional information about the input and output characteristics of the models, the types of data generated, and the key control variables.

State Information Systems

These systems are constrained by economics, and are, therefore frequently, very efficient. In state systems emphasis is placed on getting the information to the user in a form that is easily understood and utilized. In addition to other information packages, many states have relied heavily upon a map format for final information presentation. Many of the state systems do not rely on the user to correctly interpret given information and therefore use a variety of means to convey the information.

An important aspect of state systems is the education of the users and the public. The system operators must aid users in defining their heirarchy of values in relation to specific problems, and in interpreting the data pertinent to those problems. Also initially all systems will have a limited user group and will achieve increased use only when the public becomes aware of the system

Considering these points, one can see why state systems would not be applicable on a regional basis. Such individuality would probably not be possible on a larger scale.

A COASTAL ZONE INFORMATION SYSTEM FOR RHODE ISLAND

M. Spaulding[1]

P. Cornillon[2]

C. Knapp[3]

Introduction

As the pressure increases for the development of land and other resources along our coastal zones the need to properly manage these areas has become increasingly evident. With that realization has also come a need to collect, organize, and analyze information about these resources in order to shape an effective management strategy. This paper describes a system presently under development in Rhode Island to assist the coastal management community in that process.

Objective

Stated concisely the objective of the proposed system is to develop a procedure to allow the coastal zone management community to access predictive tools, environmental data, data analysis procedures, literature, and other information to assist in making management decisions for the coastal zone.

System Requirements

In the design of a coastal information system for Rhode Island, a series of system requirements were outlined based on the needs of the

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Rhode Island coastal management community and the experience of other states and organizations in developing similiar systems. It was concluded that the key to system success must be that it is simple to use so that personnel with little detailed information retrieval knowledge or computer programming experience could readily use the system. Additional system requirements were formulated and are included in Table 1.

TABLE 1 - SYSTEM REQUIREMENTS

- Simple to Use
- Rapid Response
- Flexible
  - Easily Updated
  - Responsive to Changes in Management Strategy
- Cost Effective
- Educates the User/Self Learning
- Meets Users Needs
  - Conceptually
  - Input/Output
  - Level of Confidence
- Matches Data Processing Requirements to Needs
- Input/Output Simple to Understand
- Assist in Preparation of Reports

Methodology

The methodology was to design an information system using a minicomputer system, more specifically a Tektronix 4051 Interactive Graphics Terminal and Minicomputer to provide the coastal zone manager with access to a wide variety of information and predictive tools. As developed, the minicomputer terminal is located in the office of the coastal zone planner to access environmental data, administrative review procedures, predictive models, literature and other information resources. The storage of the data and models can either be done on the minicomputer system itself or a much larger computer as the need dictates. Figure 1 gives an overview flow chart of how the system functions.

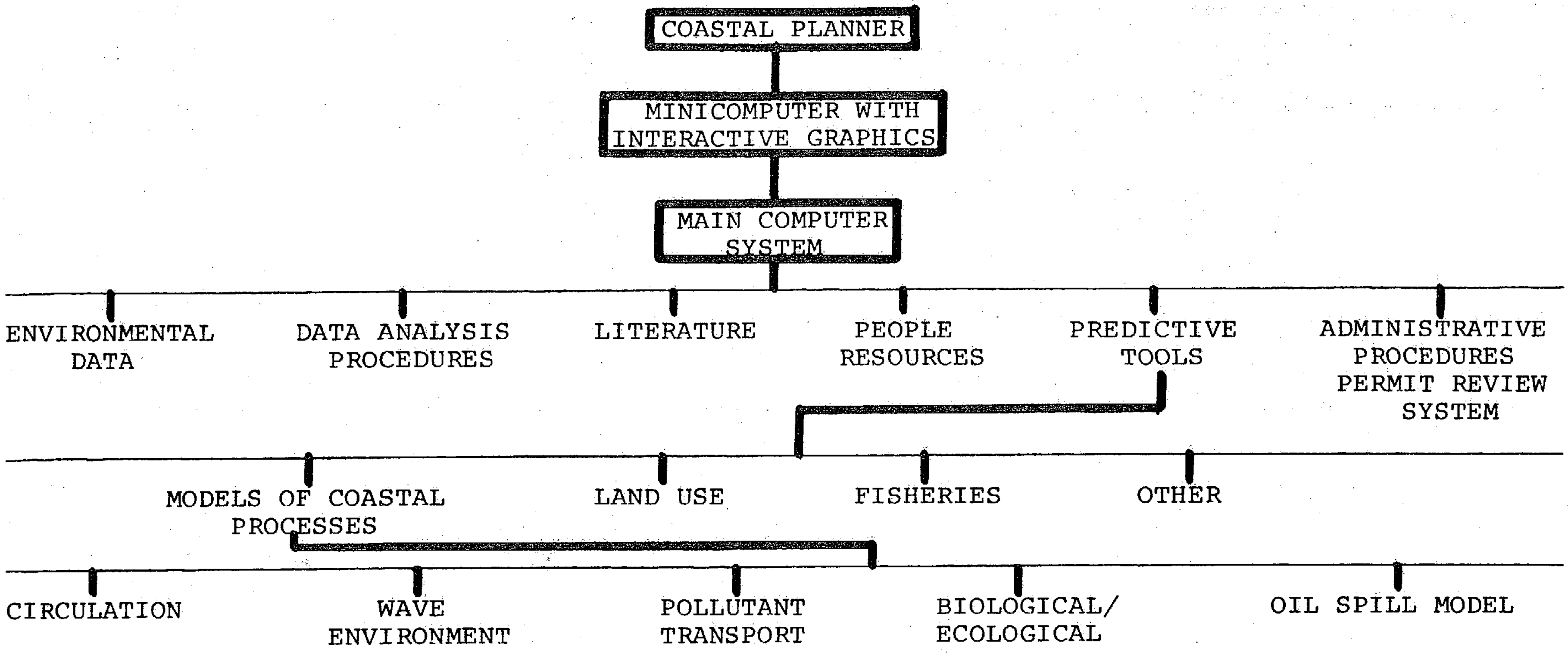


FIGURE 1 - FLOW CHART FOR THE RHODE ISLAND COASTAL INFORMATION SYSTEM

Administrative Framework

Key to designing any information system is the decision as to who the "target audience" or user community personnel are and the administrative framework within which the system is to function. Under present Rhode Island legislation the coastal zone management community is broken down into roughly three groups. The Department of Environmental Management and its Coastal Resources Division is responsible for review, field investigations, record keeping, and enforcement of the coastal alteration permit system, while the Coastal Resources Management Council establishes coastal management policy and acts as a jury in deciding permit requests. The development of long term planning and management policy is performed by the Coastal Resources Center. These three groups operate in close cooperation and coordinate with the Rhode Island Statewide Planning offices and local city and town planners as well as federal agencies to assure a consistent and effective management policy.

The proposed information system has been designed within this administrative framework and the user audiences are the Department of Environmental Management (DEM), Coastal Resources Division and the Coastal Resources Center (CRC).

Implementation

Since the system is in the early stages of development, the implementation of the system has not progressed very far. But with the small amount of experience gained to date, it appears that the critical need in implementing the system is to establish credibility with the user community. Although this may appear to be obvious at first glance, the need to continue working on this area needs to be constantly stressed. This is particularly true when one is developing predictive techniques for the coastal planner.

Other important considerations in system implementation are to proceed in a carefully planned step by step manner with user involvement being continuously incorporated in system formulation. It is also important to establish a well defined advocate in the user community such that critical feedback can be focused and addressed.

Applications

The permit application information system evolved concurrent with the development and implementation stages of the Rhode Island Coastal Management Program. The final design of the system has both affected and been affected by the permit application review process. A standard information sheet was devised in cooperation with the Coastal Resources Division of DEM and the Coastal Resources Management Council to consolidate quantifiable permit information into an easily retrievable/useable format.

The information sheet was specifically constructed to meet current and anticipated information requirements of the coastal managers. It provides rapid access to information on a spatial and temporal basis, including the nature of particular applications, trends in the permit-granting process and indications of development pressures and relative effects of the management program on the above factors.

Methodologies used in data analyses and presentation are the direct result of consensus among the system users and developers. Output techniques are developed incrementally and on a priority basis. Current needs to monitor long-term permit-granting activities have been met through the capability to generate time-related summaries of final decisions on applications, in general, or applications involving specific projects or sites. The software for accessing permit application information allows a great deal of flexibility in the ultimate organization and presentation of the information. Figure 2 gives a flow chart describing the permit application information system.

Throughout the development of the information sheet, in particular, the CRMC developed a more systematic approach in handling applications than previously followed. Increased attention to the relationship between the management program and the permit review process can also be considered a secondary benefit in developing this sub-system, particularly in light of the recent award of federal implementation monies to the State.

An interactive oil spill model has also been incorporated in the system to help coastal planners develop management strategies and appropriate responses to marine oil spills. Figure 3 outlines the organization of the program to include the necessary input to the model while Fig. 4 shows a typical example of the model output. It is important to note that the oil spill has been designed so that the information necessary to run the model is readily available from public sources such as the U.S. Coast Guard or newspaper reports on the spill incident and that the model can be run by individuals without detailed technical expertise in either computer programming or oil spill dynamics.

It is hoped in the future to include further components of the information system. Selection of the new components to be included will be done in close coordination with the user community.

Problem Areas

While the system proposed here has not yet undergone the rigors of time and, therefore, many problems have not yet surfaced, a preliminary analysis shows that getting the user community to adopt and make use of the system as part of their ordinary work schedule requires a great effort. Establishing a user advocate at the working level appears to be the preferred method to attack this problem but it is by no means a simple process.

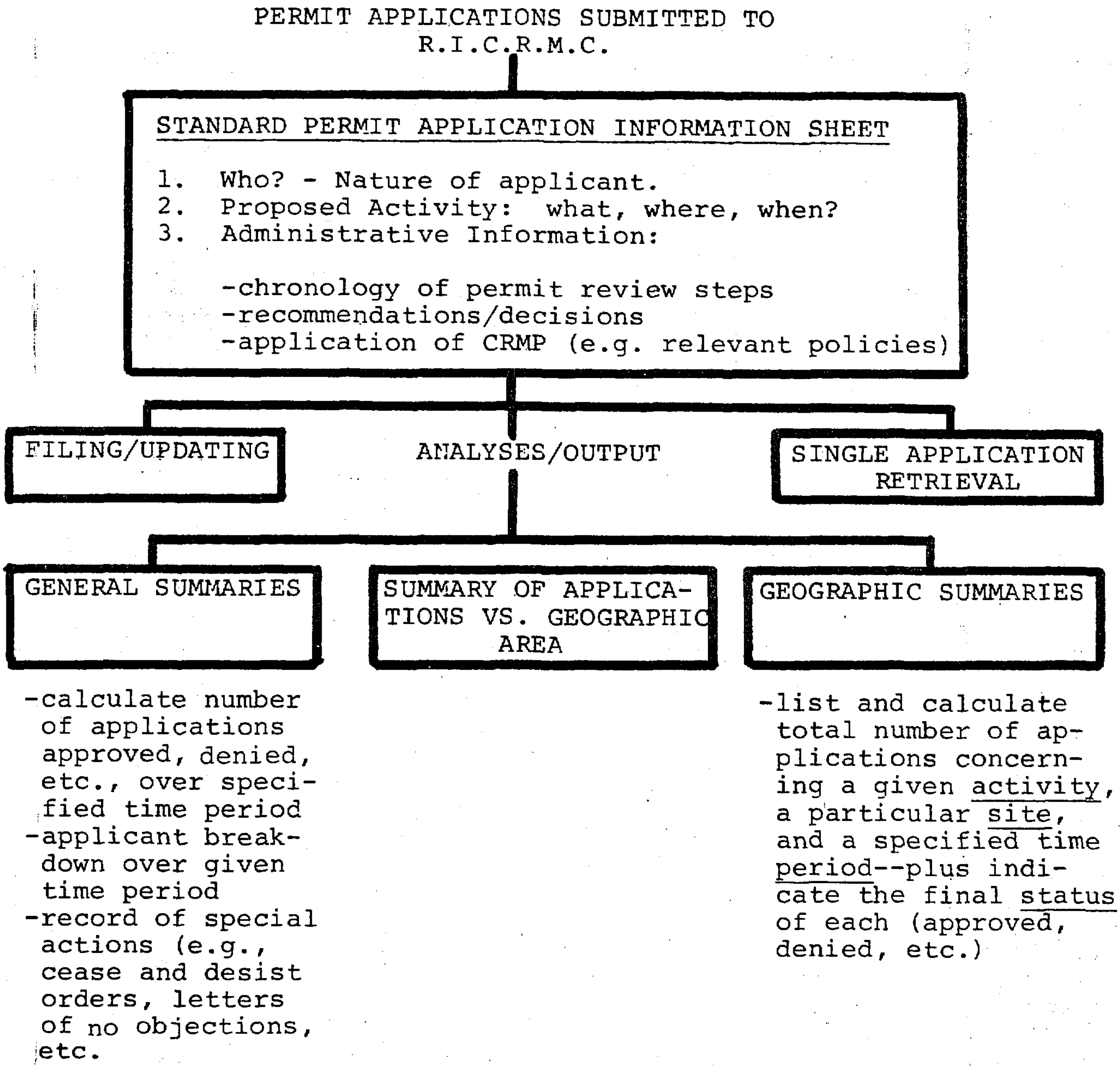


FIGURE 2 - PERMIT APPLICATION INFORMATION SYSTEM

NARRAGANSETT BAY OIL SPILL MODEL

OIL SPILL INFORMATION

1. What? - Oil Type
2. When? - Beginning Time of Spill
3. Where? - Spill Origin
4. How? - Release Type (Instantaneous or Slow Leaking)
5. How Much? - Amount of Oil spilled

WIND INFORMATION

1. Time
2. Speed
3. Direction

CURRENT INFORMATION

Check Tidal Chart to Enter the High Tide Hour at Newport in the Date of the Spill

CALCULATE WIND AND CURRENT DRIFT

SUBSPILL MOVED TO THE NEW POSITION

CALCULATE SPREADING

PLOT THE CALCULATED RESULT ON THE SCREEN

FIGURE 3 - FLOW FOR NARRAGANSETT BAY OIL SPILL MODEL

TIME= 1 HOUR(S) FROM SPILL
START AT 10 O'CLOCK, 11/10/78

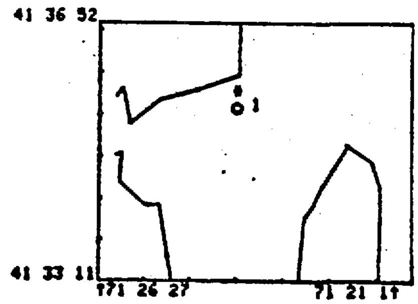
TOTAL SPILL VOLUME =
15.142 METRIC TONS

RATE OF SPILL =
15.142 METRIC TON/HOUR

ORIGIN OF SPILL, 41*35'55''N;
71*24'13''W

WIND HISTORY: (E = 0 DEGREE)

TIME (HR)	SPEED (M/SEC)	DIRECTION (DEGREE)
1	0.0	0.0



TIME= 3 HOUR(S) FROM SPILL
START AT 10 O'CLOCK, 11/10/78

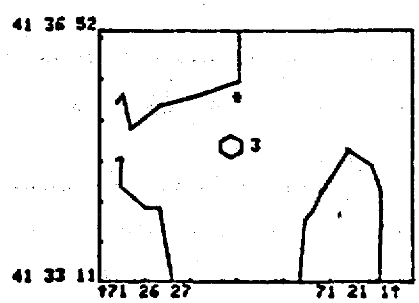
TOTAL SPILL VOLUME =
15.142 METRIC TONS

RATE OF SPILL =
15.142 METRIC TON/HOUR

ORIGIN OF SPILL, 41*35'55''N;
71*24'13''W

WIND HISTORY: (E = 0 DEGREE)

TIME (HR)	SPEED (M/SEC)	DIRECTION (DEGREE)
1	0.0	0.0



TIME= 7 HOUR(S) FROM SPILL
START AT 10 O'CLOCK, 11/10/78

TOTAL SPILL VOLUME =
15.142 METRIC TONS

RATE OF SPILL =
15.142 METRIC TON/HOUR

ORIGIN OF SPILL, 41*35'55''N;
71*24'13''W

WIND HISTORY: (E = 0 DEGREE)

TIME (HR)	SPEED (M/SEC)	DIRECTION (DEGREE)
1	0.0	0.0

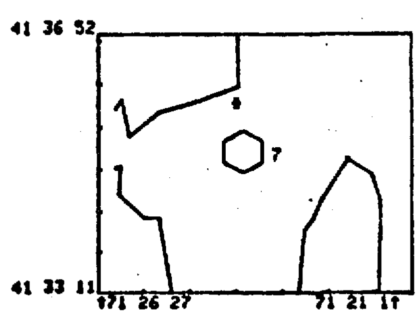


FIGURE 4 - TYPICAL EXAMPLE OF THE OUTPUT FROM THE NARRAGANSETT BAY OIL SPILL MODEL

The other critical area we have encountered, particularly in relation to the use of predictive tools, is in developing the credibility of these procedures with the user community. The assumptions of the models need to be clearly stated, reiterated and emphasized so that the level of expectations of the user group are not raised so high that when the inevitable predictive errors arise that the system developers' credibility is lost.

DISCUSSION OF LOUISIANA'S "INFORMATION SYSTEM"

Paul H. Templet

June 16, 1978

The term "information system" as used in this discussion will encompass 1) those who have the information, 2) the means of transforming the information into a usable format, and 3) the manager at the state and local level all operating within the context of the state's Coastal Zone Management Program. It has been my experience that it is not enough to merely develop a computer based information system. Concurrently, existing with the computer based system must be the requisite institutional framework which can provide financial, educational and technical liaisons between the developer of the information and the user of the information. The remainder of this paper will deal with the developers of information, the minipulation of that data into usable formats, the user, and finally the institutional arrangements necessary to make the whole system work. The goal is to provide the necessary technical information to the manager in a usable format so that he can make resource decisions that achieve the coastal zone management objective of balancing growth and conservation.

Basic Data and Those Who Have It

There is probably already enough basic information developed and available for most Coastal Zone Management Programs. The quantity of information contained in state and federal agencies and in the universities is massive, but has never been transferred to the managers at the state and local level. There are, of course, areas which have not been researched and every coastal management program should spend small amounts, in the range of 10% or less, on research which is applied to answering questions which have developed in the course of the management program development. This type of research should be management oriented and, necessarily, short term. Making grants to universities to do open-ended research concerning broad coastal management topics has not proven to be successful or useful. The problem area centers around the question: How do we keep universities involved and interested when the frontiers of knowledge which they wish to explore are too far removed from the manager's needs?

If we accept the premise that there is enough information available to develop a coastal management program but that it is in the wrong format and virtually unusable, how do we make it usable?

Tools for Information Transfer and the User

There are a number of formats by which information can be transmitted from the information gatherer to those who must use it. Among these are written reports, newsletters, briefings, maps and computer-related outputs. A mix of these is perhaps the best approach to try, but a format that has worked the best in the

Louisiana program involves maps. Experience indicates that managers have little surplus time and rarely read reports. However, they will look at a map if the information is clearly presented and easily interpretable. A map has the additional advantage of being able to show the overall context in which a particular piece of real estate is being studied. Thus, the manager acquires a holistic approach to environmental management and gains an understanding that, even though the permit he is processing may affect a small part of an estuary, it is, nevertheless, part of the larger unit and affects that larger unit.

The primary user of the information developed is the coastal zone manager at the local or state level. To a lesser extent, the user will be federal agencies, the general public and others working in the field of coastal management. Having determined the user to be the coastal manager at local and state agencies of government, the next step is to develop a listing of what kinds of information should be mapped. We were unable to obtain from local governments any understanding of their informational needs, primarily because they had had little experience in management at the local level.

In developing our list of data needs to be mapped, we first concentrated on the obvious features of the natural environment which are important such as vegetation (or ground cover), elevation, hydrologic characteristics and topography. Added to the list were those things which need to be mapped because of man, such as prime agricultural and forestry lands; land use (existing and projected); historical, cultural and archeological sites; unique ecological features; and potential preservation and restoration areas. A third type of map dealt with information which could be derived from existing data by minipulating data. These included soil subsidence potential, land loss potential due to channel construction, and land surface feature classification (based on NASA satellite imagery). This last type of information (i.e., the derived information) was based on analysis of problems which had been determined by earlier studies. For instance, there were problems with the siting of residential developments on filled wetlands. The filled wetlands are underlain by many feet of organic peats which dewater and oxidize to cause subsidence. Houses built on this type of soil inevitably cause great problems to the homeowner in the form of cracked slabs, walls, etc. and to the local government trying to provide services with continually cracking water, gas and sewer pipes and broken roadways.

Having mapped most of this information, it became apparent that merely providing a set of maps to the user would not necessarily encourage him to use the information in a way which would balance conservation and development. A problem developed in that the manager may not use the correct information in making his decision since he had a number of maps to choose from. If he uses the existing land use map and decides to site new development adjacent to existing development he may discover, too late, that he's merely perpetuating existing mistakes. To solve this problem, we recognized the need to integrate all of this information into a single recommendation for siting development of any kind in the Louisiana coastal zone.

Thus, we are developing a set of maps which will illustrate development potential based on land suitability (Figure 1). For storing, manipulation and mapping data, a series of computer programs called IMGRID was chosen. Any land-based information which can normally be mapped by conventional means can be incorporated into a data file for analysis using IMGRID. IMGRID allows for the graphic display of terrain characteristics for virtually any size or shape study area and at any scale. A grid size of four hectares (9.88 acres) was chosen based on the available level of resolution of the information. The grid was laid out across the Louisiana coastal zone using Universal Transverse Mercator coordinates. It was determined that 32 different variables (see attached list) could be mapped and used in the IMGRID System. Thus, one data point for each of 32 variables was digitized into each 4 hectare grid representing 32 data points per grid. There were about one million grids across the Louisiana coastal zone representing 32 million digitized data points.

However, IMGRID cannot make decisions concerning the relative importance of subsidence or the location of a bald eagle nest as a hindrance to development.

There is a way to combine apples and oranges as long as the resultant is called fruit. The way that we have chosen is to convene a panel of experts and have them make a collective decision as to whether subsidence is more important as a hindrance to development than a bald eagle nest.

However, rating the relative importance of 32 different variables to development would be a difficult, if not impossible, task. To provide some assistance to the team of experts rating the variables we used a technique called Interpretive Structural Modeling (ISM) (Figure 2). This technique is one which is designed to help people think and communicate more effectively about complex issues. There are three basic operational steps involved in application of the technique. Given (1) an issue context, the first task is to extract a set of (2) relevant elements and (3) a meaningful relational statement. It has been used in the past for a number of things, including factors in intercity investment decisions, grouping of children with learning disabilities, and structuring the Goals for Dallas. For our use, the issue context was one of determining the relevance of 32 variables to constraining development. The elements were the 32 variables and the relational statement was "Is ______ more important than ______ in constraining development." The blanks are to be filled in with the variables being compared. The technique was implemented in a man/machine interactive environment in such a way that human users are responsible for making subjective judgements while the computer is employed in an unobtrusive manner for bookkeeping and for performing and displaying the results of simple logical operations. The procedure worked well and allowed us to develop a list of variables indicating their ranking in importance for constraining development.

To answer the above question of whether a bald eagle nest is more important for constraining development than soil subsidence, the answer is that endangered species' habitats had the highest importance for constraining development while soil subsidence was sixth in the list. The rankings were fed into the computer to structure the 32 million data points and the maps are presently being developed. They will be ready by August 15, 1978 and will be bound in as the

Suitability Model Flow Chart

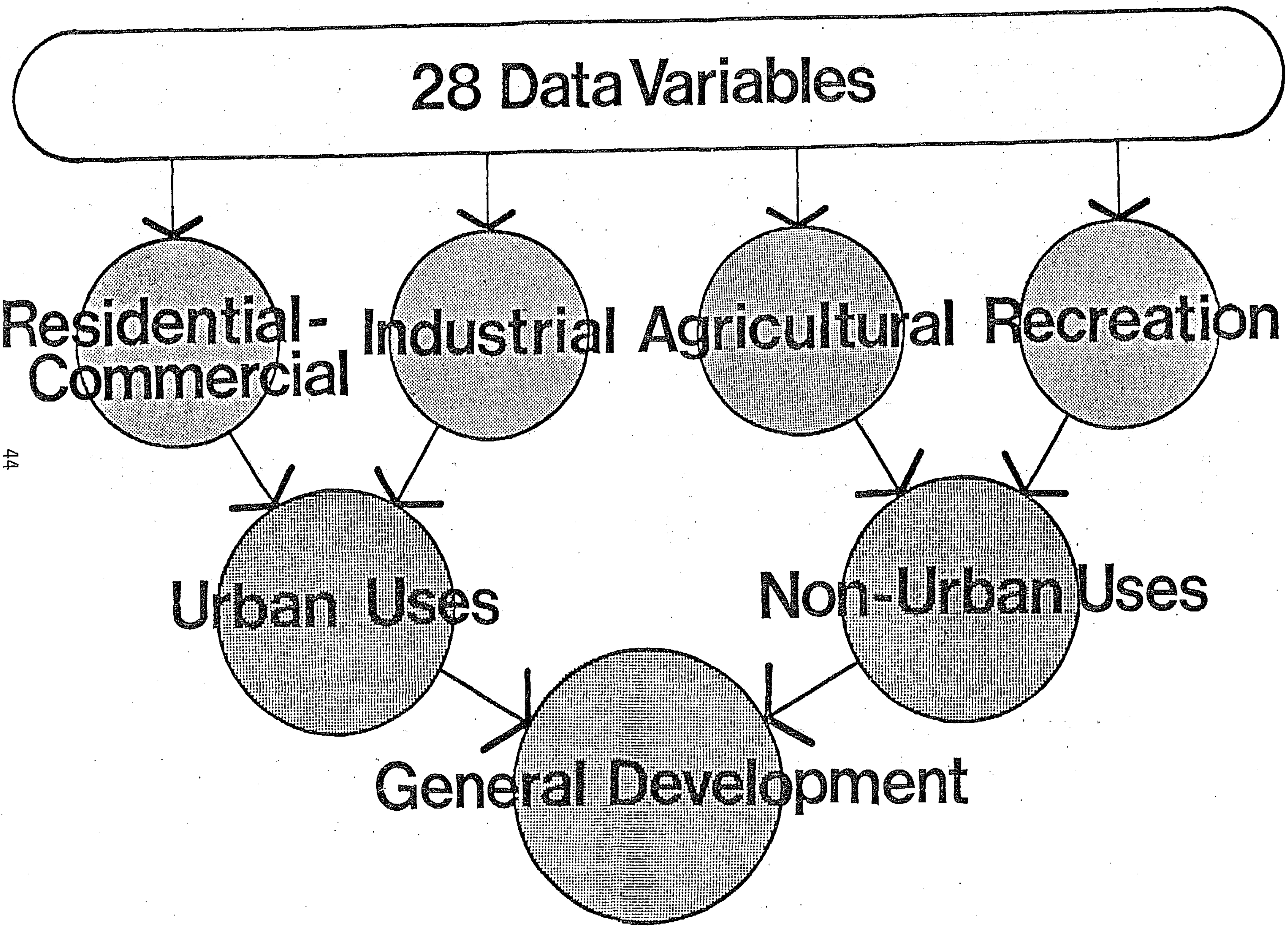
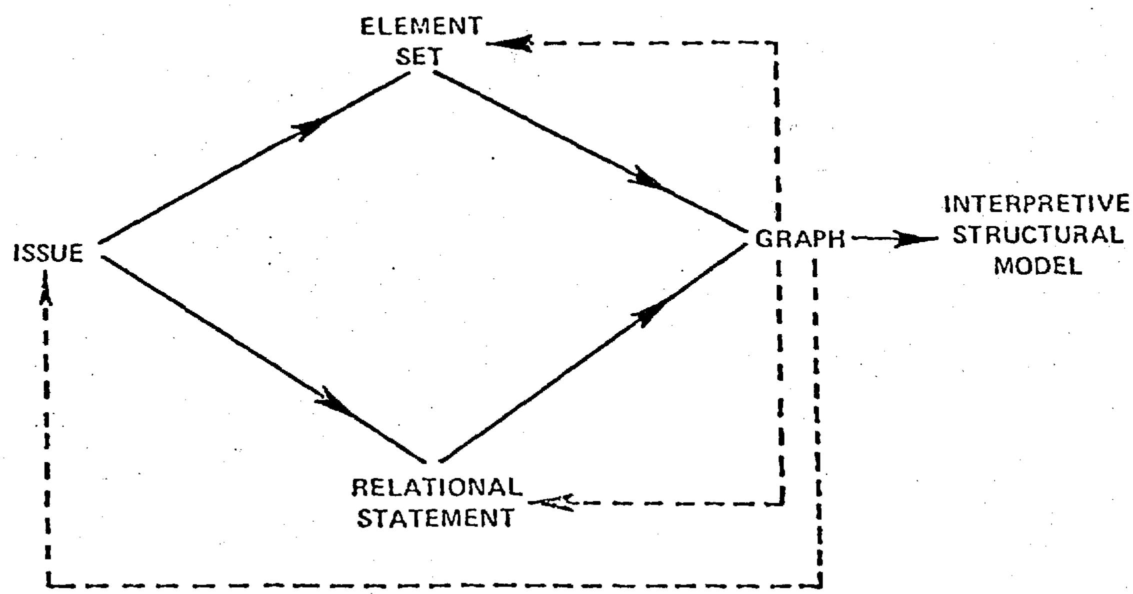


FIGURE 1

FIGURE 2



BASIC CONCEPTUAL ELEMENTS AND OPERATIONS
INVOLVED IN THE ISM TECHNIQUE

ILLUSTRATIVE EXAMPLES OF ELEMENTS,
RELATIONS, AND STRUCTURES

Elements	Relations	Resulting Structure
People	" . . . reports . . . "	Organization Chart
Objectives	" . . . supports . . . "	Intent Structure (Objectives Tree)
Variables	" . . . is a function of . . . "	Mathematical Model
	" . . . is relevant to . . . "	Relevance Tree
	" . . . influences . . . "	Trend Interaction Diagram

final map in a series of maps for each parish (county) at a similar scale and size. We anticipate that these maps, especially the development potential map, will be extensively used by managers and others in making decisions concerning siting of developments in the coastal zone.

Institutional Framework for Implementing Information Transfer

The final, but essential, part of the information system is the institutional framework for implementing the transfer. Approximately two years ago we contracted with 17 local governments and required, as a part of the contract, that an advisory committee be set up which represented a balance of conservation and development interests. We made recommendations concerning the types of persons who could be part of this semi-technical advisory group but left the appointing strictly up to local governments. The number of advisory groups increased in the second year as 21 parishes contracted to develop their local coastal zone management plans. The advisory groups were to be a technical assistance resource for local governments which could assist in the development of the coastal zone management plan at the local level and, in the future, provide assistance to local governments in handling permit applications which would require some technical analysis. As we developed rough copies of the individual maps which were to be part of the final parish Atlas they were submitted to each parish's advisory committee for their comments and modifications. The modified maps were then turned over to the mapmakers for a final version. In this way, local government advisory committees had a substantial amount of input into the development of the maps which were destined for the Atlas. In addition, the process worked to educate the advisory committees and to train a pool of persons who could respond to requests for technical assistance from local governments. The system has worked well and we have used the advisory committees in a semi-technical capacity for evaluating other things such as reports and projects. We have attempted to strengthen their role by working through them whenever possible. It is not enough merely to develop data and package it in a usable form. There must be a trained receiver on the end of the information transfer process. The principle problem in this step involved those parishes which did not work with us in developing their coastal zone management plan. How were we to receive their advice and provide assistance to them?

Summary

In summary, our information system consists of (1) those who have the information at the university or agency level, (2) repackaging information into a usable format by the Coastal Resources Program, and (3) managers at the local level who have participated in the design of the information format and are, thus, familiar with it and, hopefully, aware of its usefulness.

Attachment 1.

	Ranking in Constraining Development			
	Residential and Comercial		Industrial	
Samples of Variables Considered	Human Variables	Natural Variables	Human Variables	Natural Variables
Maximum Elevations		11		11
Minimum Elevations		8		9
Potential Departures		10		10
Soil Subsidence Potential		6		7
Land Loss Potential		6		2
Geologic Features of Particular Concern		4		5
Areas of Significant Shoreline Reconfiguration		3		2
Hydrologic Resource Characteristics		5		4
Potential Flood Hazard		5		6
Potential Washways and Inlet Formations		3		2
Endangered Species Habitats		1		1
Terrestrial Habitats of Particular Concern		9		8
Botanical Features of Particular Concern		2		3
Existing Land Use	2		2	
Non-Urban Public and Semi-Public Lands	4		5	
Dwelling Units	6		2	
Recreational Areas of Particular Concern	5		3	
Transportation Types	8		6	
Parish Infrastructure	8		7	
Historical Sites and Landmarks-Archaeology	1		1	
Areas Appropriate for Preservation	3		4	
Unique Features	7		8	
Significant Boundaries	9		9	
Vegetation		7		7

The Marine Environment and Resources Research and Management System at the Virginia Institute of Marine Science (MERRMS at VIMS)

John B. Pleasants
Executive Assistant to the Director
Virginia Institute of Marine Science

The Marine Environment and Resources Research and Management System (MERRMS) has been operating at the Virginia Institute of Marine Science (VIMS) since early in 1971. It has progressed from an initial rudimentary collection of documents to a comprehensive point of information on the marine environment and related subjects, such as coastal zone management. The emphasis quite naturally is on the Chesapeake Bay and the Virginian Sea, which is sometimes referred to by the uninformed as the "middle Atlantic bight." Although this is the area of its concentration, MERRMS contains some information on other areas of the country; but the further one wanders from the waters of the Commonwealth, the less information in our system one is apt to find.

To understand why this is so, as well as the thrust behind the development of MERRMS, it is necessary to understand the position occupied by the Virginia Institute of Marine Science in the hierarchy of the Commonwealth.

VIMS is to my knowledge unique. It is a creature of the Commonwealth, and placed in the executive branch of the state government in the Secretariat of Commerce and Resources. It is also an educational institution, serving as the School of Marine Science for the College of William and Mary, with our director double-hatted as dean, and most of our professionals holding faculty rank. We have a strictly graduate program with about 110 students in pursuit of masters or doctorate degrees, which are awarded by William and Mary. For this reason, there are those who feel that the institute more properly belongs under the Secretary of Education. The code of the Commonwealth is ambiguous on the subject, referring to the Institute once as an independent research and advisory agency, and twice as an educational institution.

VIMS has no management authority over the marine resources of the Commonwealth, but serves as advisor to the managers, such as the Virginia Marine Resources Commission (VMRC) and the State Water Control Board (SWCB). In fact, VIMS provides advice to all state institutions whose work impinges on the marine environment or its creatures. We also supply advice to individuals and citizen's groups as well as industry when we feel it to be in the interest of the Commonwealth to do so.

It is this advisory portion of our mandate that led to the creation of MERRMS. As is often the case with advisors, we frequently found that we didn't have enough information to make a really good comment; but even more frustrating was the knowledge that the information was available somewhere but couldn't be pulled together in a reasonable time. MERRMS, then, is an effort to pull the information together ahead of time and make it rapidly available by the use of computers, special indexing and advanced visual displays. It is often used as a "war room" or "Combat Information Center (CIC)" in our informational efforts. Here we bring together those with problems, our experts and the readily retrieveable information which MERRMS contains. Those of you with naval experience no doubt remember the purpose of CIC on board warships is to collect, collate and display information, and this was one of my guiding principles while developing MERRMS.

Let us now examine the elements that make up MERRMS--the various sub-units that are accessed to provide the information we disburse. When I was first given the job of creating MERRMS, I set about collecting relevant, easily available--but scattered-- data, already at various locations at the Institute. These included topographic maps and county highway maps of tidewater areas, National Ocean Survey charts of all western Atlantic waters, including all those available of Chesapeake Bay, and all the aerial photos from whatever source that had been collected over the years by individual researchers for various projects. Incidently, trying to make a logical, easily searchable file of aerial photos from several different sources with no discernable common denominator is a study in itself, one which I recommend to those among you with an avid interest in both jigsaw puzzles and cryptology. With these basic moves behind me, I had already built a considerable data base without really expending a great deal of effort or money. True, the information had been at the Institute before, but now we could always lay our hands on it in one place.

I decided early on that we needed a small, special purpose library, and the decision was made at about this point to make it an all microform library. I decided that we should use microfiche, and that we should have the ability to make our own. Both of these decisions were to prove fortuitous. Microfiche masters are clear mylar jackets into which strips of microfilm can be slipped. The form we use is about 4" by 6" in area, and hold sixty frames of 16 mm microfilm. These sheets--as many as necessary--properly titled and numbered can be placed in a special envelope and filed as a publication. These microfiche masters can be copied very quickly and inexpensively. Our little machine copies two sheets about every forty-five seconds, at a cost in materials of slightly over a nickel per sheet.

We have three types of readers with which to read our microfiche--there are the portable readers, which we check out, the stationary ones which have variable magnification and are slightly larger, and the reader-printer which can give us a hard copy of any page we desire. Microfiche gives us one more advantage. Copying is so simple and inexpensive that a request for a particular document can be sent out by return mail at a reasonable cost. Local users can take a copy of a publication and a portable reader with them. Since the master never leaves MERRMS, our files are always one hundred percent up to date.

The microfiche files now total about seven thousand nearly identical packets of microfiche, representing an equal number of documents, neatly filed in a four-by-six card file. The problem that immediately leaps to the inquiring mind is that of indexing. How, in fact, are we able to rapidly locate information in this melange of material? Before answering this question, I would like to apologize to any professional librarians who may be present. For some reason, a description of my filing system seems to cause them pain. It does have two redeeming features, however, I understand it, and it works!

I started by establishing several categories into which our work logically falls. These may be place names such as James River, or Virginian Sea; biota, such as striped bass; things, such as power plants; or phenomena, such as tides or erosion. All publications are read on receipt, assigned to the most appropriate basic category, and cross-filed under up to three others. A publication on the effects of power plants on oysters in the James River might be filed under "power plants", and cross-filed under "oysters" and "James River". We also maintain an author file in which we list every author.

We have found that these means of retrieval, however, are not enough. Consequently, we also assign descriptors from a list that is based on the water resources thesaurus produced by the Department of the Interior which has been modified for local use. We did this by removing descriptors in which we have no particular interest--"apple trees" comes to mind--and adding others, mainly place names. We allow up to ten of these descriptors to be assigned to each publication. This enables us to search our holdings by computer for any descriptor or combination of descriptors. The machine will print out, on demand, all titles to which the desired descriptors have been assigned. Should we ask it, say, for "York River" it will give us quite a long list. If we add the descriptor "blue crab" it will search for those titles to which both have been assigned and give us a much shorter list. If we ask for the right hind flipper of the blue crab in the York River we probably won't get anything, but that's the way it works.

I felt, then, that we needed a mechanism to tie all this information together--a means to present data in such a way that it would be equally comprehensible to the layman and the scientist alike. The means I chose was a visual display. My first attempt was a series of charts with plastic overlays. The chart would set forth the area of our concern, and the plastic overlays would show factors affecting the area in which we were interested--a sort of modified McHarg technique. The factors would be such things as oyster grounds, fish spawning areas, wetlands, marinas, clam grounds, sewage outfalls, salinity, power plants and so forth. We soon found however we had so many charts--and so many overlays per chart--that handling them became mechanically infeasible.

I hit upon the idea of replacing the chart and overlay system with random access slide projectors coupled with rear screen projection. This has gone a long way toward solving the problem. Our configuration has five projectors, one of which covers nearly the entire projection screen. The others cover the four quadrants of the screen, and the projections of these four in sum cover the entire screen. The centered single projector is used to "set the stage". We show here the area in which we are interested. Then, using our random access capability, we remove that picture and replace it with pictures in the four quandrants, each of which shows the same area but displays a different factor of the sort I previously listed, the effect is as though we are displaying simultaneously four charts of an area, each with a single plastic overlay depicting one factor. Since we also have random access to these slides, we can replace any factor with another, showing it against any three other factors. Our capacity, without changing carousels, is four hundred slides. Since carousels are readily changed, the system is virtually limited only by the industry of our art and photographic shops.

These are the basic present components of MERRMS. There are others associated with MERRMS, but which are not necessarily located therein. These include:

- The Chesapeake Bay Bibliography.

  This is a listing, in several volumes, of all references to the bay and surrounding marine areas of which we are aware. The publications listed have been assigned descriptors from the same list utilized for the MERRMS microfiche file, and can be computer searched in the same manner.

- The VIMS data banks.

  This is all the hydrographic data available at VIMS, mostly the product of our own research. Again, the emphasis is on the Virginia Sea/Chesapeake Bay area. Other information--such as fishery statistics--is also available.

Having described MERRMS, I come now to the real crux of the matter, which is the question of use. How, in fact, is it working, to what uses is it put, and who are the users?

To start with, we keep very accurate records of each "use-visit" to MERRMS. This enables us to know--and to demonstrate--exactly who is using the system, for what purpose and at what rate. Users fall naturally into two classes, in-house and, if you will pardon the expression, out-house. The in-house users include nearly all of the professionals at VIMS. The aerial photos, maps and charts, the microfiche file and the visual display are all used frequently. MERRMS is the scene of many problem-solving meetings of small groups, usually two or three VIMS personnel and a like number from another organization with a marine related problem. MERRMS is also used for briefings, and here the visual display is particularly useful.

Out-house users are of many types. They include, state and local officials, non-VIMS academics, environmentalists, consultants, and industrialists.

State and local officials of the coastal zone were furnished at the start of the Commonwealth's coastal zone management planning effort with microfiche readers and a microfiche copy of a printout of MERRMS document holdings. Each month they receive a list of our acquisitions. They order those they need, and microfiche copies are sent. Both the basic list of our holdings and the monthly update are computer printouts, and they show all descriptors assigned to each publication as well as the title, author and so forth. This gives perusers an excellent idea of the contents of each document before ordering.

Industrial and consultant users are particularly fond of the microfiche category file, especially the place name categories. Here are listed all documents pertaining to any marine-related body of water in the commonwealth in which they may be interested. It is not uncommon for these users to order fifty or more microfiche copies of documents. They also are the most frequent users of the computer search capability for documents.

Visiting academics also use the microfiche file, as do environmentalists. Their method is generlly to review the category of their subject, noting the file numbers of documents of interest. These are pulled and scanned on the readerprinter, with items of interest being copied. Occasionally they order a microfiche of a document to take with them, which we make while they wait.

Another feature involves dissertations and theses of our graduate students. All of these are microfiched in MERRMS, and when one is requested on loan by another institution, they receive a crisp, clean microfiche copy instead of the usual dog-eared "loaner".

This is the way MERRMS is presently constituted. It has been in at least partial operation since 1971. For an original outlay for equipment of less than $10,000, MERRMS has provided service to hundreds of people in the Commonwealth and, indeed, all over the nation and the world.

Our future plans include a computer terminal in MERRMS to give us nearly real time access to the hydrographic data base, the computerized index to the microfiche and the other information contained in the institute's organic IBM 370-115. We also plan to establish communication with other information systems of which we are aware. Further, we intend to develop a plotting capability in MERRMS.

One final question to consider is what changes I would make if I were starting again on MERRMS. These are two things I believe I would try to do differently

- MERRMS needs much more physical space. It is currently all located in one room, and there are obvious interferences when different sections are to be used simultaneously.

- I would get into the computer terminal set-up earlier.

All in all, I believe MERRMS has worked out well. There are of course minor regrets when one looks back.

The Land Use and Natural Resource Inventory of New York State

Ernest Hardy

A detailed inventory of land use and natural resources is generally recognized as a prime requisite for effective planning. Although such inventories are rarely undertaken on a statewide basis, or for similarly large land areas, New York State has recently accomplished this using aerial photographs as the source of information and computers to store an and analyze this information.

The Land Use and Natural Resources (LUNR) inventory was designed to be of prime use to the Office of Planning Coordination and other major planning agencies. It is serving that purpose, and is additionally useful to many other agencies and individuals, consequently, similiar inventories are being developed for other states and countries. Land-use information is of interest to all planners and, depending on its quality, can greatly influence decisions affecting the future uses of large areas of land. To be effective, the information must be used; but to be of maximum use it must be up-to-date, easily understood, flexible in its presentation format, economically produced, and readily available. The New York State LUNR information meets these requirements, but achieving that goal required extensive research and development of techniques.

To transfer information from many sources to a standard base in a unified format is difficult, and ready-made solutions were lacking. Since the project was large enough to demand the full-time efforts of up to 50 workers, it was necessary to adequately standardize procedures so that different persons would make the same decisions from the same sources of information about an area.

The framework needed for such an approach was developed from a standardized grid system already in use with the 7½-minute United States Geological Survey map series, with a ratio or scale of 1:24,000. From many alternatives, the grid system selected was the Universal Transverse Mercator (UTM) which permitted working within a framework of square cells, each representing a uniform piece of New York's land area. The UTM grid is based on quite accurate metric measurements from the equator and from a given longitudinal line. Most of New York State is in one zone centered at 75° of longitude. Using the metric system, UTM permits uniformly square cells to be subdivided into smaller cells, representing very small areas, if desired. Also, each cell can be assigned a unique number for identification. Such a grid-cell system is the major link between inventory information and the many uses or products that can be developed from the inventory, and additionally, cell size can be adjusted to the needs of the inventory users. For this project, it was agreed that a one-kilometer-square cell would be a useful summary unit on a statewide basis. A smaller cell size might increase the locational accuracy somewhat, but at increased cost. Since larger cells have the opposite effect, choice of cell size involves the trade-off point at which acceptable accuracy balances its cost-benefit value.

If visualized as a giant "pigeonhole" framework superimposed over a map of the state, the grid system thus becomes a practical location reference into which inventory information for any cell can be placed as it is gathered. Each square kilometer is permanently identified by a six-digit number reflecting that square's distance east or west of 75° longitude and north from the equator. These digital identifications are unique for each cell and provide a positive means for access and retrieval of descriptive information that has been stored within the system.

Aerial photographs of the state taken in April and May of 1968 became the major source of information for the inventory. Other sources included existing maps (such as the generalized geology and soil association maps), reports and directories, public agency records, direct contacts with Cooperative Extension county agricultural agents, and government officials in most counties. All provided certain types of information not readily available from other sources.

Photo interpretation and data from supporting sources could be compiled before the grid was applied to the map, since cell locations were not necessary to the development of map information. We tested automatic and semi-automatic means of mechanizing the interpretive and locational parts of the process but found it more satisfactory to manually transfer information to the maps with the aid of rulers and other simple devices.

We placed information on the maps so that three basic forms of measurement for information retrieval and preparation for computer storage could be used. Points of specific interest, but representing too small an area to be recorded, were counted and assigned to the proper cell record and manually recorded on work sheets. Areas of land use were measured by a fine grid representing areas of 1/100 of a square kilometer, called mini-cells. The land-use category to which a mini-cell was assigned was determined by the use being made of one-half or more of that mini-cell, meaning that land-use decisions were based on areas as small as 1¼-acre in size. In certain instances they were measured in even greater detail. The third form of measurement was linear, as for mileages of shorelines, railways, and so forth. Information that can be located on a map and measured in one or more of the ways mentioned can be simply incorporated into the inventory.

Adequate preparation required as little as two days for some area maps (about 50 square miles) and up to three weeks for maps in complex surburban areas. Field checks for accuracy involved driving over some of the roads shown on each map, comparing roadside observations of land use or natural resources with the photo interpretations. As correct and incorrect decisions were compared with the total decisions that should have been recorded, a "grade," or ranking of accuracy, was assigned to each map. In this project, the graded maps usually had an accuracy level of 92 percent or higher. Maps receiving low grades were revised to attain acceptable quality.

When we had finished locating information on maps and measuring and recording it, the data were prepared for computer processing and storage.

Familiar card and tape methods of data management were tried, but they proved of little use in attaining the high degree of flexibility necessary to obtain maximum use of the inventory. Card and tape storage proved too inflexible, restricted the ease of making corrections or additions, and posed major problems for future development and comparison procedures that would be needed in time-sequence studies of land use.

To make the data readily accessible we employed a computer disk-storage system having two major capabilities: (1) random access to any item of information in any cell, and (2) extended storage capacity far beyond foreseeable needs of the inventory. It permits rapid transfer of information, inexpensive corrections, easy updating and addition of new data, and has the degree of retrieval flexibility needed to make the inventory a valuable planning resource. The current inventory requires storage capacity for some 275 items for each cell, while the disk storage system will accomodate up to 10,000 items of information for each cell.

The LUNR inventory provides point, linear, or area information on 11 major categories of land use. agriculture, forest land, water resources, nonproductive land, residential land use, commercial areas, industrial areas, extractive industry, outdoor recreation, public and semipublic land uses, and transportation. Each category contains more detailed classification units. Also, statewide information on generalized soils and bedrock geology and on the economic viability of farm areas has recently been added to the inventory. The items in the inventory can be retrieved in any combination for any desired area of New York. Unlike a typical data bank, organization of the material does not restrict the combination of retrieved inforamtion. Any combination can be produced, and any mathematical or logical analyses can be made of the data.

Five inventory products are of general interest to potential users: overlay maps of area information, overlay maps of point and linear information, work books that record data for each cell, a computer product (DATALIST) that lists information about each cell (either "raw" from storage or mathematically manipulated), and maps produced by the computer (PLANMAP) indicating the location and results of various quantitative analyses of the data. All of these items are available at moderate or low costs.

The first three are of value in matters dealing with smaller areas. They are easily read and require little training for interpretation. Computer processing offers opportunities to manipulate information in the inventory for special purposes. From the thousands of possible DATALISTS or computer-graphic maps that can be produced it is doubtful that more than a few hundred will ever be called for. Yet users can make requests of a flexible source and receive information in any of several formats. Such requests can now be filled usually in less than a week for any area of the state, and at a variety of scales.

In compiling the inventory, we have tried to maintain complete neutrality and objectivity in processing the information; the reward for this is great flexibility in the use of the inventory. For example, knowledge of the locations and amounts of agriculturally inactive lands is important and valuable to a wide range of users, including planners, farmers, naturalists, commercial and university researchers, and others. Had that land been identified in a way that predetermined or prejudged the use of the information, it conceivably might not be acceptable to any of the intended inventory users.

The LUNR inventory differed in many ways from the usual survey of this type. Its classification system provided comprehensive area coverage and discrete identification for each of 50 land uses based on descriptions of unique characteristics. As a result, every acre of land in the state was classified. Rather than a one-time enumeration, the inventory is in reality a dynamic planning tool. Stored inventory information can be manipulated by computer to provide either numerical data or computer-graphic maps; and anlayses can be produced very rapidly for any town, county, watershed, or region of the state. Techniques developed for the LUNR inventory provide opportunity for successive surveys to offer time-sequence comparisons, and the system of recording and storing data allows insertion of new information whenever it becomes available.

The Minnesota Land Management Information System (MLMIS)

Alan Robinette

Within Minnesota, resource data are collected for many different projects and by many different agencies. The United States Forest Service conducts a forest inventory. The Soils Department of the University of Minnesota and the U.S. Department of Agriculture Soil Conservation Service compile soils maps. The U.S. and State Geological Surveys map geologic formations. Many agencies purchase air photos and produce various maps. The Department of Natural Resources records state ownership of land. The list goes on and on. Many people seek this information for application to a variety of resource problems. Each person faces the problem of synthesizing the data and putting them into a usable format.

Government officials must use data and analysis to make decisions. Often decisions are made at different levels of government. A zoning permit is granted by the county, another permit by the Department of Natural Resources, and perhaps a third by the Environmental Quality Board. Each group compiles and looks at the information in different ways; often the information is different and each group reaches a separate conclusion. If conflicts occur, each group argues based on its own data and analysis, and often without adequate data. A common base of data could eliminate some of the arguments and alleviate distrust of other data. The realization that these problems create conflict and make decisions more difficult has prompted an attempt to solve then in Minnesota. One solution is to establish a common data base and computerized analysis techniques that can be used in analyzing resource-related problems.

The Minnesota Land Management Information System is the product of more than twelve years of effort by individuals in state government and at the University of Minnesota. These people were concerned about the state's capability to deal with land management and environmental problems. Much of this concern derived from the importance of the environment as a major source of recreation in the state and the need for the state to manage its large landholdings. (It is claimed that only the federal government and Alaska are greater landowners than Minnesota.)

The Legislature, concerned about the importance of outdoor recreation sites, passed the Omnibus Resources Bill in 1963. This law earmarked a part of the state cigarette tax for outdoor recreation and created the Minnesota Outdoor Recreation Resources Commission (since renamed the Legislative Commission on Minnesota Resources (LCME) to administer the funds.

The commission first began to collect information about outdoor recreation. Later it funded the collection of data that identified state-owned lands, a survey of the state's population to determine recreational use of lakes, and a map of seasonal home locations.

In 1967, the commission funded a state inventory by the University of Minnesota Department of Geography of lakes not publicly owned whose basins exceeded 150 acres. This inventory compiled data on the location of seasonal and permanent homes, dominant soils and vegetation types, lake ecology and road accessibility, plus samples of land and building values and homeowner attitudes and characteristics.

Aside from the tabulations and identification of specific resources or resource combinations, the most significant result of the lakeshore development study was the establishment of a computerized data bank containing all the information used in the study. Some 38,000 40-acre cells were encoded with data from nearly 2,000 lakes, and it was obvious that the data bank compiled for the study could be a valuable management and research tool for government decision-makers.

To obtain information on land use, SPA coordinated the purchase of aerial photography of the entire state in 1968 and 1969. This information was encoded into the growing data file as the first complete statewide element. By 1971, a map which displayed land uses for the entire state by 40-acre parcels had been produced. In 1973, appropriations were authorized for adding new data elements covering the entire state to the system. Enough potential for MLMIS was seen by the SPA and the Department of Administration's Information Resources Development Fund (IRDF) to encourage continued funding for research and development of the system. In 1977 the state legislature appropriated funds moving the program to the SPA in July 1977.

The 1977 Legislature funded the Land Management Information Center (LMIC) to increase use of the data and analysis system by all state agencies and by the private sector. LMIC is a division of the State Planning Agency with a service bureau theme. It is not intended to serve the SPA exclusively, or even primarily. It is available on an equal basis to all state agencies and departments.

A committee of people from agencies that use the MLMIS will advise the Center on additions and changes to the data base and analysis system. This committee should help to increase interaction among the user community. Special project costs for computer time and programming work above present funding can be contracted with outside users.

LMLIC is organized into three functional sections: the Mapping and Remote Sensing Information Center (MARSIC), the Planning Analysis Service (PLANS), and the Minnesota Land Management Information System (MLMIS).

MARSIC centralizes mapping and remote sensing information for the state. Catologs of Minnesota's aerial photography and mapping products are compiled and information on other remote sensing and mapping data can be obtained from the center.

PLANS is the application section of LMIC; it provides assistance to users of the data and analysis system.

MLMIS is the system section; it maintains the data base, develops new analysis tools, and enters new data.

The primary reason for the existence of any computerized system is the data base. The MLMIS data base has been in development for several years and now is operational statewide. The features of the data base that will be explained include the cell size, the type of data, and the data entry techniques.

The 40-acre parcel is the smallest geographic entity identified in the system; it is based on the U.S. Public Land Survey. The U.S. Public Land Survey (PLS), first conducted in Minnesota in 1848, divided the land based on principal meridians and base lines. A six-mile square area called a township is identified by a township number based on a north-south distance from a base line, and a range number based on an east-west distance from a principal meridian. Each township is divided into 36 one-mile square sections; each section is further divided into quarter sections and quarter-quarter sections. The quarter-quarter section is 40 acres in size and one-quarter mile on a side.

The PLS 40 was chosen as the basic cell size for MLMIS because historically it is the basis for allocating land in the state. In addition, many governmental taxation and land ownership records are still indexed by the PLS designations. In areas where land ownership has been fragmented from the original 40-acre parcel, enough information exists to aggregate the land back to the original 40 acres. In fact, the lines defining these parcels are often visible in ground development as the locations of roads and urban streets, as property boundaries, or as boundaries for various natural resource management practices. Also, the size of the 40-acre unit is convenient for computer mapping and analysis of data covering relatively large areas.

Alternative cell sizes can and are being used for specific purposes in conjunction with MLMIS. For smaller areas of the state, data have often been collected for cells of 2.5-acres or even smaller. At the statewide level, a file of data of 5-kilometer cells, or approximately 10 square miles, has been created. The specific size cell used for an individual site should be a function of the data available and the budget of the particular project. More detail can be included in a grid cell covering a smaller area, but the cell size need not include more detail than the best available data.

The second aspect is a description of the data itself. There are thirteen different items of information or "variables" recorded for each of the 1.4 million 40-acre parcels in the state. For each variable, an individual 40 may have one characteristic or "data level". Variables on a statewide basis may have a number of data levels: e.g., there are nine land use types and 50 different public ownership types. The thirteen statewide variables include the following:

1. Township - The public land survey township.

2. Minor Civil Division - Incorporated municipalities, organized rural towns, and unorganized territories are entered as defined by the Bureau of the Census.

3. Public Ownership - Publicly owned lands of federal, state, or county jurisdiction.

4. Type of Acquisition of State or County-Owned Land.

5. Highest Recommended Use of State or County-Owned Lands - as determined by the Department of Natural Resources Land Classification Study.

6. Recommended Disposition of State or County-Owned Lands - as determined by the Department of Natural Resources Land Classification Program.

7. Management Unit Status of State or County-Owned Lands - as determined by the Department of Natural Resources Land Classification Program.

8. Land Use - as determined from aerial photographs.

9. Forest Cover - as determined by the U.S. Forest Survey.

10. Water Orientation - different water features that are within or adjacent to a parcel.

11. Highway Orientation - roads and road intersections that occur within or are adjacent to an individual parcel.

12. Soil Landscape Unit - as determined by the Minnesota Soils Atlas.

13. Geomorphic Regions - physiographic features as determined by the Minnesota Soils Atlas.

In addition to these thirteen variables, some areas of the state have additional information on file. The Arrowhead region, for example, has information on geology and zoning and an additional soils variable. Region Six East has detailed variables on agricultural land use. The LMIC will maintain the data base on a statewide basis and will assist other groups who wish to enter data to meet their needs. Other statewide data will be entered or updated as it becomes available and feasible to enter. Several possibilities, such as data on elevation, slope, watershed, and land cover as seen by satellite are being explored.

Data may be entered into the system in several ways:

- The most commonly used method, manual coding of the information is a tedious process for the entire state and requires a great deal of time and manpower.

- A second way to enter data is through a computer process called digitization. In this method a scanning devise records polygons of similar information which are then translated by computer to fit the file structure of the data base. For the MLMIS data base this means converting polygons into the appropriate sized grid cells.

- A final entry method is the merging of records by a common identifier. The PLS code is common to ownership records and becomes the method for entry of state ownership information. The computer matches the state records with the MLMIS data file and inserts the information where appropriate.

The Environmental Planning and Programming Language (EPPL) provides the means by which the data base is analyzed. The capabilities of EPPL expand as new needs and analysis techniques are required. Because of the method of storage, EPPL consists of several routines in one major software system and a number of efficient satelite programs to meet particular needs. File manipulation, map compositing, and cell-to-cell relationship analysis, which are discussed below, show the system's range of capabilities.

The file manipulation capabilities that are used for analysis are the window and scale change. The window capability allows the user to select a portion of a larger map to be used in further analysis. Thus, a township file can be extracted from a county file for computer efficiency and will provide only the information requested. The scale change software has several useful capabilities for analysis. It allows the user to reduce or expand the area included within cells or the basic data unit. For instance, one might change the 40-acre cells to section-sized cells of 640 acres or, in the other direction, to 2.5-acre cells. Larger cells can enable the user to study a larger area, such as a region, with less cost and maps that illustrate general patterns with more clarity. Smaller cells can allow a user to coordinate the 40-acre MLMIS data base with more detailed information collected for a specific site.

Maps compositing (or cell analysis) capabilities consist of three different techniques.

- The first, called bigtab, allows the user to create a new map with a data level for each combination of two variables. Thus, nine levels of land use bigtabbed with six levels of water orientation could combine to form 54 levels in a new variable, one level of which might be forest cover adjacent to lakeshore.

- A second, called flow, permits the creation of a new map that is based on logical paths through multiple variables. An example might be to map all cells that are forested land use, with oak forest cover, on lakeshore that is not publicly owned.

- A third compositing capability is the score procedure. The score method assumes that the user can assign quantitative values relative to the characteristics of each variable and to the importance of each variable in the compositing process.

The cell-to-cell relationship allows the user to evaluate geographic relationships in the analysis. This differs from compositing (above) in that compositing looks at only one cell, whereas geographic relationship analysis looks at surrounding cells.

- One important function in this type of analysis is the ability to find an edge between two adjacent cover types. This is called an edge analysis. For example, an edge which is valuable wildlife habitat in this type of analysis could be the area where marsh and forest cover meet.

- A second geographic relationship comes from view analysis, which examines the characteristics of the area around a defined point to see if they are visible. Thus, the user can find a "view shed" for a location or a bluff line from a road. This form of analysis requires the use of elevation and vegetation height.

- A third type of geographic relationship analysis examines the characteristics of a group of cells to assign a value, perhaps the median, to a central cell. Examples of this might be finding the range of elevation values around a point to assign a measure of topographic diversity to that point.

A data base or computer analysis is meaningless unless the results can be "output" in a form useful to planners and decision-makers. A variety of output tools are available to MLMIS users depending on the particular needs of a study.

The most commonly used output device is the standard line printer. Maps can be output on this device using each letter or character as a cell. Because the line printer does not print square characters, the map output will be scale distorted, that is, a square area will not come out as a square map on this device. These maps are often useful for interim output for checking errors and for preliminary examination of analysis maps. The line printer can also be used for output of tabulations and statistical tables.

A second output device used to preview data or test analysis is the desk top interactive terminal. On this device, it is now possible to map and analyze an area up to 40 cells wide by 50 cells long. This method is useful for demonstrating the data base and analysis capabilities, but it is also scale distorted.

A third output device is called the Varian electrostatic plotter,commonly, dot plotter. This device allows the user to control dot patterns to create grey tone map symbols. The size of the output cell can be varied from .01 by .01 inches to .25 by .25 inches, thus, producing different scales of maps geometrically correct. This device is very useful for producing low cost display or work maps for use during analysis. Another output created is a three-dimensional representation of a map, which is often used for visualizing a landscape or dramatically portraying some (statistical) phenomena.

A fourth output device available to LMIC is the "DICOMES" image recorder. This device can produce high resolution color or black-and-white film directly from computer data. Use of this process enables the production of high quality color or grey tone maps suitable for mass reproduction.

The MLMIS is an operational system that can be used by anyone. The full potential of the system will not be realized until use of the data is understood and used by the people involved in resource analysis. As use develops, new data and analysis capabilities will be needed. The Land Management Information Center will attempt to meet these needs and assist users in the use of any aspects of the present system.

Regional Coastal Information Centers

Recognizing that state systems have limited resources and that national systems could effectively answer local users, the concept of regional systems was recently developed by NOAA. Centers were established with the charge of providing regionally specific information for local and state decision-makers. Essentially, the systems must contain sufficient information to answer regionally specific questions in sociology, economics, engineering, law, and oceanography. They must also be able to tap the information base of existing local systems.

Centers have been established in the Northeast, Northwest, and Great Lakes areas. These systems are in their infancy and therefore have the opportunity to avoid the problems encountered by earlier systems. By encouraging early participation centers can tailor their data to fit the users' needs and establish themselves as beneficial systems to the region. Already the number of information requests to the centers have increased as a result of the drive to involve users in the development of the systems.

Northeast Regional Coastal Information Center

Charlene Dunn

As steward of the nation's oceans and coasts, the National Oceanic and Atmospheric Administration (NOAA) has been called upon to answer questions from citizens, private interests, and public agencies about such varied concerns as coastal zone management plans, industrial development, new energy resources off our shores, the impact of the new 200-mile economic zone on the fishing industry, urban waterfront blight, pollution from oil spills, marine transportation, and property loss from erosion and natural hazards.

Providing pertinent information about these concerns requires broad expertise in such fields as sociology, law, engineering, resource economics, oceanography, and land use planning. On a nationwide basis, the job of answering questions comprehensively has become very difficult.

Clearly, some method of disseminating information on a more manageable region-by-region basis was called for. To this end, NOAA has established a network of Regional Coastal Information Centers (RCICs). Piggybacking the RCICs onto Sea Grant Marine Advisory Services provides them with a solid base of existing information and access to the field specialists.

First of the RCICs to be established, the Northeast Regional Coastal Information Center (NERCIC or Coastal Information), provides information to the coastal New England states and to the Long Island area of New York State. In operation now for one year, the Center has been taking inventory of, assessing and indexing the coast-related information sources in the region; libraries, depositories, special collections, experts, publications, and non-print materials.

A project of the New England Marine Advisory Service (NEMAS) - an association of marine advisory, extension, and educational programs in the northeast, established to share professional resources and to work cooperatively on projects of regional scope - the NERCIC's day-to-day operations are at the University of Rhode Island. Housed within the Graduate School of Oceanography's Division of Marine Resources, the NERCIC is close to many excellent coastal and marine information sources, most notably the National Sea Grant Depository.

The NERCIC uses the Division of Marine Resources Library (DMRL), formerly the planning collection of the Coastal Resources Center (the technical arm of Rhode Island's Coastal Zone Management Program), as its back up collection. This valuable resource consists of approximately 2600 coastal-related volumes with notable special collections on OCS, nuclear and alternate energy, and Rhode Island coastal resources.

The NERCIC maintains several specialized files for coastal information and they are:

- The Master File, divided into two parts, which contain the results of the inventory and assessment of documentary information sources.

  1) The Short Form Directory which includes brief descriptions of the assessed information sources subject areas and the user audience. Also within this directory is a listing of special collections and a description of the overall capability of the Center.

  2) The shelf list holdings which are larger, more complex information sources. These are catalogued with cards indicating the coastal information related volumes of the assessed source. These cards can then be searched at the NERCIC for accurate referral or for interlibrary loan;

- The Resource File contains a listing of experts to be referred to for coastal and marine resource information.

  This listing contains vital statistics such as address, title, areas of expertise, and pertinent publications or projects. Also listed are those experts' expressed areas of interest;

- The Pip File (Pre Information Package/Public Information Packet) which is a system of modular stack drawers, each with a specific subject designation, for use by those whose information needs are of a nontechnical nature.

  These drawers contain information worked up for prior requests such as short, annotated bibliographies, summaries of issues and problems, new developments not yet documented, newspaper clippings, brochures and fact sheets.

  This file can also be used to construct information packages for requestors or can be used with short publications to give a more complete answer to the requestor;

- The Requests Answered File contains all answered inquiries, filed by subject area, to be referred to when researching similar requests, ensuring that staff effort is not needlessly duplicated.

The establishment of systems and procedures to ensure prompt, accurate and effective response to all inquiries was the major emphasis of the NERCIC's first year. During the year the NERCIC answered approximately 700 requests for information in 17 different subject areas. A governor's nuclear energy advisor requested socio-economic impact research and studies on rural communities; the New England Aquarium needed a list of inexpensive and readily available coastal publications for marine educators; the New England Sea Grant communicators asked for a list of available publications for the fishing industry; a planning student came to the Center for assistance with research on dry septic systems for use in coastline homes and on regulations governing their use. All inquiries are answered. An evaluation form to assess the accuracy and usefulness of the first year's answers will be mailed soon to a random sample of inquirers.

Other services are also being provided by NERCIC. A bimonthly newsletter, Coastal Information, has been established to address timely issues and detail pertinent resources available on the subject. An informational brochure about the center and the proposed RCIC network has been developed. A monthly acquisitions list arranged by subject area is regularly distributed and a holdings list of all NERCIC documents will be published this year. The NERCIC coordinated an update of the Rhode Island Marine Bibliography, to be available in November 1978, which may be used as a component for a NERCIC-sponsored bibliography for the entire Northeast. A cooperative project was started on several specialized searches of the National Sea Grant Depository data bank. These will be available in January 1979. An annual report detailing the Center's first year is now being compiled.

Future anticipated products and services will be a series of short information packages, or summaries, of coastal issues and areas; an explanation of the unique indexing system and suggestions for its utilization by other centers or groups; a user's education workshop, and other projects which will be announced via the newsletter.

Coastal Information: It's all out there in a big, unorganized, and inaccessible lump. The centralized source, NOAA, sensibly divided the job of organizing and disseminating it into smaller, more localized units, the RCICs, which now must reverse this process and build up a knowledge of regional resources and needs, piece by piece, source by source, locality by locality. Each regional coastal information center will then pool its findings into a national network.

Coastal Information? Ask your local regional coastal information center. One source, one answer. The total national perspective.

Northwest Coastal Information Center

Robert Holton, Oregon Station Coordinator

Questions concerning federal and state laws, offshore oil development, coastal fisheries, estuarine systems, and many more subjects arise almost daily along the Pacific Northwest coast and Puget Sound shoreline. Under the federal Coastal Zone Management Act of 1972, both Oregon and Washington have developed planning goals and procedures for their coasts. Local governments and citizens have helped the states create workable methods for coastal management.

Yet wise, long-range coastal and shoreline management depends heavily upon accurate, timely information. Coastal county and city planners, citizens who participate in advisory groups, scientists and lawyers, and state agency staff need answers to the questions that affect sound coastal management decisions. Such information may take the form of other states' coastal plans and laws, scientific papers, oceanographic or climatic data, consultants' reports, environmental impact statements, or court decisions and legal interpretations.

Recognizing the Northwest's need for a comprehensive source of coastal information, Oregon State University, the University of Washington, and the Oregon Estuarine Research Council have established the Northwest Coastal Information Center (NCIC). The NCIC, the second of nine regional coastal information centers planned for placement around the country, is supported by three agencies of the National Oceanic and Atmospheric Administration (U.S. Department of Commerce): Office of Sea Grant, Office of Coastal Zone Management, and Environmental Data Service. The NCIC will become the core of a regional reference and referral network to serve local and state resource planning agencies, legislators, industries, and citizen groups with useful information in such fields as environmental laws and regulations, coastal and shoreline management plans, and estuarine and coastal processes.

The NCIC consists of two stations. The Oregon Station, located at Oregon State University's Marine Science Center in Newport, Oregon, will house information on Oregon's coastal management plan as well as scientific and technical information relevant to Northwest coastal management. The Oregon Estuarine Research Council has loaned its collection of documents and reprints to the Oregon Station. The Washington Station, part of the University of Washington's Coastal Resources Program in Seattle, will concentrate its collection on Washington's coastal management plan and on shoreline laws, regulations, and management issues.

In its initial year (1978), the NCIC will primarily address its services to those most directly involved in coastal management: local planners, state agencies and legislators, and citizens groups. As the center's resources expand, it will reach out to additional user groups and citizens.

Each NCIC station will provide similar services to users. The two stations maintain direct and continuous contact to coordinate services and acquisitions and to make possible quick exchange of documents for loan to users.

Current services the NCIC can provide are:

- referring users to experts on coastal processes, laws, and management;
- locating and arranging for access to hard-to-find documents and reports issued by state and local agencies;
- producing bibliographies of publications on coastal subjects;
- identifying and accessing useful information from other states;
- circulating a regular bulletin that lists by subject the titles of documents, research publications, and reports acquired by the center;
- helping to provide access to oceanographic and coastal data generated by federal agency research.

The NCIC plans additional services, such as compilations of information on selected coastal topics and "translations" of complex legal or scientific documents so that they can be more easily used by those concerned about the coast. The NCIC also has close ties with Oregon State University's Extension Marine Advisory Program, and the University of Washington's Sea Grant Marine Advisory Service, to ensure that users with specific and urgent needs gain the assistance they require.

A few special NCIC service, such as computer literature searches and photocopying, will of necessity be cost reimbursable.

Great Lakes Information

Nancy Huang, Great Lakes
Regional Information Referral Center

GREAT LAKES INFORMATION is the third regional information center in the national network sponsored by NOAA. It was established in June 1978 as a joint operation of the Michigan Sea Grant program and the Great Lakes Basin Commission, in whose offices it is located.

The ultimate goal of GREAT LAKES INFORMATION is to increase the exchange of water-related information and data in the Great Lakes region. It will serve as a focal point for information requests on water and related land resources in the region, serving as a bridge between all potential information seekers and the available information resources. Initial major efforts have been launched

--to identify, assess, and document the existing information systems, networks, services, collections, programs, current research projects, and scientific experts within the government agencies, private and academic institutions, universities, businesses, communities, citizens' groups, etc.

--to disseminate widely the assesed findings in order to enhance awareness of and access to existing resources.

--to promote awareness, cooperation, and coordination among existing facilities in order to minimize creation of unnecessary systems and duplication of effort.

--to provide reference and referral service to the general public as well as those directly involved in managing, developing, conserving, and understanding water and related land issues of the Great Lakes region.

--to reach out to all prospective user groups, make them aware of the availability and accessibility of the existing resources, and encourage and educate them in making the fullest use of these resources.

--to conduct a regional user needs assessment to identify unmet demands for consideration in setting up any future information system or services.

GREAT LAKES INFORMATION will be unique among centers in the NOAA network in its greater concern with the international aspects of information exchange. The Great Lakes are a binational resource, and information about them is developed and used in both the United States and Canada. Canadian federal and Ontario provincial representatives participate actively in the Basin Commission and its Coastal Zone Management Committee.

National Information Systems

These systems are directed at the planner or policy decision-maker as the prime user. This requires that the systems can be easily accessed and that the information resulting can be understood and used, consequently the systems are promoting user education programs. Most systems also produce their information in many different formats to suit the varied needs of the users. To provide ease of access the systems allow users to address the system directly, eliminating the need for an intermediary.

These national systems and their subsystems were established independently of one another and as a result there is a problem of interfacing between the system. Currently, efforts are underway to link the systems. Through this networking, a user will be able to find information more efficiently and completely.

AN OVERVIEW OF THE UPGRADE DATA ANALYSIS SYSTEM

John D. Buffington
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Laurence J. Milask
Sigma Data Computing Corp.

I. INTRODUCTION

UPGRADE is a highly integrated set of computer programs and databases designed for the rapid analysis and presentation of environmental, health, economic and policy data. The principal users of the UPGRADE system are intended to be environmental analysts, program managers, and policy/decisionmakers, rather than computer and technical specialists. The use of completely interactive computing techniques which employ step-by-step English language prompting and responses, menu tables and other devices provide explicit instructions to the general user. The UPGRADE technique is an alternative to the traditional command or "natural language" software system which requires users to learn complex key word vocabularies and syntax rules, which often involves a substantial learning period.

The UPGRADE analytical and display capabilities include database access and manipulation, data handling and statistical analyses, graphic and tabular displays, and geographic mapping procedures.

The current databases available under UPGRADE include data from EPA's STORET and SAROAD systems, USGS' National Stream Quality Accounting Network, NCHS' National Morality Data, Special Drinking Water Data, and miscellaneous socio-demographic files. Equally important has been the establishment of standard access procedures for obtaining new data from Federal agencies. For instance new water quality data from STORET can be obtained and made available under UPGRADE in one to four days depending upon the complexity of requirements and computer facility operating schedules.

Finally, the UPGRADE system includes a pilot integrated database system (IDB)* which includes national health, water quality (drinking) and demographic data integrated at the county level. Future efforts (FY79) will include the expansion of the IDB with additional mortality

* The IDB is also known as CLIDE (County Level Integrated Database and Extraction). CLIDE Reference Manual, March 1978.

and morbidity data, air quality and possibly emmissions data, and more demographic information. Also, the IDB software will be improved to provide additional user facilities and retrieval options as well as cross-indexing at other geographic and subject area levels.

UPGRADE was developed by CEQ with the cosponsorship of EPA and DOE. Other participants have been USGS, Water Resources Council, National Cancer Institute, and the State of New Jersy.

II. UPGRADE - Interactive Analysis and Graphic Display Capabilities

Philosophy and Operation

The fundamental philosophy underlying UPGRADE's design and operation is "Serve the User." This approach does not mean that computer use is inefficient; however, it does mean that the end product must be directly and conveniently accessible to the end user, that is, the environmental or policy analyst or program manager. To accomplish this result, the following design and operational approaches are employed:

- UPGRADE is largely an interactive system, meaning that users may directly approach and design their own analyses without programmer intervention.*

- The interactive system employs step-by-step English language prompting coupled with extensive "Help" documentation for each UPGRADE prompt. The English language prompting and "Help" facility make UPGRADE largely self-instructive and result in a short learning curve. "Terse" prompting mode is available which enables rapid sequencing for experienced users.

- Immediate access is provided to all UPGRADE databases which are on-line, and very rapid access for UPGRADE data files stored on tape. On-line (Interactive) database overviews are provided to permit easy evaluation of database content.

- Finally, UPGRADE is designed to guide users through a logical sequence of analysis steps that promote a consistent and reliable approach to any analysis problem.

UPGRADE Sequence of Operations

The UPGRADE analysis and graphics system is divided into three

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* Initial establishment of databases for use with UPGRADE does currently require expert programmer intervention.

major components, which are accessed sequentially:

a. Terminal Initialization and Operational Mode Selection.

b. Database Selection Section.

c. Data Analysis and Graphics Section.

The one condition or assumption that must be noted to properly understand the following discussion is that all datasets or files to be used during any given terminal session must be "on-line" and ready for use with UPGRADE. If the data desired for analysis is on tape or within the main Integrated Database System, it must first be "retrieved" or transferred to UPGRADE "ready files" through the use of special retrieval and data extraction programs.

A. Terminal Initialization and Operational Mode Selection

Users signing on to UPGRADE must first sequence through a series of prompts designed to tell the system what type of terminal is in use, the line speed, and certain graphics options required. For instance, although UPGRADE is designed to produce graphics interactively on a Tektronix CRT terminal, it is also possible to run UPGRADE on a standard (non-graphic) terminal. If graphic output is required, the graphs will be stored for later processing on some other type of plotting device (CALCOMP plotter or line printer).

Operational Mode refers to the way the user and the system interact. Two modes are currently operational, "Verbose" and "Terse." These differ in the length or detail of the English language prompts issued to the user. The Verbose mode is for those users who are new to the system or who have not used UPGRADE in several months. Terse is for experienced users and cuts down on prompt length and detail, which consequently speeds up the terminal session. Finally, the user is prompted to view a general news broadcast consisting of various messages describing recent system changes, problems, and events.

B. Database Selection Section

UPGRADE permits users to select and analyze any number of distinct datasets or files which are "on-line" and ready for UPGRADE use. UPGRADE prompts users to select first the type of data or database to be used (e.g., air quality, water quality, environmental health, etc.), and then the specific file (e.g., water quality data covering pesticides in the Colorado River).

Once the user has selected a particular field or data set for analysis, the user is prompted for several functions appropriate to the type of data under analysis. These sets of prompts constitute a Database Interface Module (DIM) and consist of several of the following functions:

- Dataset Overview - permits a general review of content, period of record, and special variables and codes for the dataset under analysis.

- Basic Statistics - summary statistics for various subsets of the data under analysis can be obtained. These statistics consist of means, standard deviations, ranges, period of record, and number of observations for variables covered.

- Data Sub-selection - specific sites or geographic areas may be selected and combined from the total collection of data within the dataset. These subsets are then made available to the final section of UPGRADE: Data Analysis and Graphics.

- The DIM may also provide very specialized data handling capabilities associated with specific databases. For instance, a land use modeling procedure for the State of New Jersey's Coastal Location Acceptability Method is now under design as a special database and DIM for UPGRADE. Another example is CEQ's Pollution Abatement Cost Evaluation (PACE) system to be used to help predict the abatement costs for various environmental control sectors (automotive and waste treatment facilities). DIMs for these special areas will include operations for modeling, table generation, and special mapping overlays.

Once the analyst has sequenced through all operations within the selected DIM, the third and final section of UPGRADE is entered to perform general data analysis and graphics display. Note, the final result of the operations within a DIM is usually a subset of the database or dataset under analysis. This subset is passed to the Data Analysis and Graphics section for statistical analysis, graphics and mapping.

C. Data Analysis and Graphics Display Section (DAG)

The DAG is composed of a simple monitor (actually a sub-monitor within UPGRADE) and a collection of analytical and graphics procedures. The DAG monitor prompts the analyst to select one or more of these procedures. The procedure, such as bar charting, then takes over and prompts the user for specific setup and run requirements, performs the required work, and finally returns control to the DAG monitor for the next procedure selection.

The Data Analysis and Graphics Section of UPGRADE has the following characteristics:

- Users can cycle through any combination of procedures to perform analysis and graphic display.

- Some procedures such as the Statistical Analysis System (SAS), produce new data, which may be used by the graphic display procedures.

- Automatic sequencing through sets of variables may be set up for selected procedures for rapid coverage of a dataset.

- A special plot modification procedure enables users to tailor graphs to enhance display and improve analysis capabilities.

A comprehensive description of the UPGRADE system is given in the UPGRADE USERS MANUAL, available August 1978 from the Council on Environmental Quality.

Socio-Economic Environmental Demographic Information System

Harvard Holmes

The objective of the SEEDIS project is to establish a coherent, comprehensive, computer-based information system for energy policy analysis, environmental impact studies, and other socio-economic analysis applications. Many LBL projects contribute significantly to the SEEDIS system by supporting research and development of retrieval, analysis, anddisplay programs; others utilize existing software but contribute new data resources. The system contains a variety of large data bases, such as the 1970 Census, air quality data, geographic base files, and land use data, that are accessible through on-line retrieval systems over the ARPA network, dial-up terminals, and remote batch stations. A comprehensive set of user-oriented re-trieval, analysis, and graphical display modules provides tables, charts, and maps, both on interactive terminals and on high-quality hardcopy output.

SEEDIS activities include acquisition and installation of data bases required for specific projects, the documenting and cataloging of those data, and the implementation and investigation of data retrieval, analysis, and display techniques. The new data bases acquired, upgraded, or developed this year by CSAM included:

- General

  PARAP (Population-at-Risk to Air Pollution) data bases, containing geographic, demographic, air quality, and mortality data for California

  Selected portions of APPAR, a populations-at-risk data base developed by Systems Sciences, Inc., in the EPA Univac 1100

- Socio-Economic Data Bases

  Quarterly data on employment and wages by establishment, for eight western states for 1974, 1975, and first quarter 1976 (similar in content to County Business Patterns, but more current, comprehensive, and finely disaggregated)

  Total population estimates as of 1 April 1970, 1 July 1973, and 1 July 1975, and per capita income for 1969, 1972, and 1974, for all U.S. counties and minor civil divisions (1975 Revenue Sharing file from U.S. Bureau of the Census

  Population, labor force, and unemployment projections, by county, to 1978

ES202 employment and earnings data, 1967-74, U.S., by county and two-digit Standard Industrial Classification (SIC) code.

- Demographic Data Bases

  Population by county for 1 July 1973, 1 July 1974, and 1 July 1975, and net migration and number of births and deaths by county for the period 1 April 1970 to 1 July 1975

  Net Migration by county, 1960-70

  1970 U.S. Census, Fifth Count by Block Group and Enumeration District (BG/ED) and Minor Civil Division and Census County Division (MCD/CCD).

- Environmental Data Bases

  Air quality data for many pollutants, western U.S., through 1974, from the National Aerometric Surveillence Network (NASN)

  Sulfur dioxide and sulfate air quality data from the Sulfate Regional Experiment (SURE)

  1975 EPA SAROAD (Storage and Retrieval of Aerometric Data) yearly summary data for seven pollutants

  Endangered species by county

  1960 air quality data from Buffalo, New York.

- Energy-related Data Bases

  Energy technology coefficients (requirements and residuals) from the BNL Energy Model Data Bases

  Operating characteristics and emissions data for California power plants

  Technology coefficients for advanced energy technologies

  Operating data from the Niland Geothermal Loop

  Experimental Facility in Imperial County, California.

- Mortality and Health Statistics

  Age-adjusted annual mortality rates by sex, race, and county, for 35 types of cancer, for 1950-69 combined (used recently by the National Cancer Institute to produce <u>Atlas of Cancer Mortality, 1950-69</u>

  Age-adjusted annual mortality rates by sex, race, and county for 53 causes of death, for 1968-72 combined

Third National Cancer Survey, containing complete cancer incidence data, 1969-71, for seven SMSA's by census tract and two states by county

Extract from Third National Cancer Survey, containing additional detailed information obtained by interview of 20 percent of all cancer patients

Complete 1972 mortality statistics (extracts from individual death certificates), from National Center for Health Statistics (NCHS)

1960 mortality data from Buffalo, New York.

— Cartographic Data Bases

MED-X (Master Enumeration District List, extended) containing latitude-longitude coordinates and an associated FIPS geocodes (tract, county, SMSA etc.) of all 230,000 BG/ED's in the U.S.

World Data Bank II, containing latitude-longitude coordinates of all coasts, islands, lakes, rivers, and intercoastal boundaries of the world: U.S. state, and Canadian province boundaries for North America.

Geographic boundaries of EPA Federal Regions, and BEA (Bureau of Economic Analysis) areas

Boundaries of EPA AQDR's for California

ERA SAROAD SITE Directory, containing latitude-longitude coordinates and other information for all U.S. Air Quality Monitoring Stations

County geographic centroids (calculated from polygon boundaries) and population centroids (calculated from MED-X) for California.

— Geocode Conversion Files

Geocode Conversion dictionary, EPA (SAROAD) county Codes to FIPS county codes

Geocode conversion dictionary, NCHS county codes to FIPS county codes

Geocode conversion dictionary, Tekrekron county codes to FIPS county code.

SIRAP/REAP

Implementation of the SIRAP (System of Information Retrieval and Analysis for Planners) Data Display and Mapping Facility was the main emphasis of the ongoing SIRAP project. An interface was constructed between the Quick Qwery retrieval and report generation system, the MAPEDIT map extraction system, and the CARTE and SYMAP data mapping packages. Thus, SIRAP data can now be retrieved and mapped in a single computer job.

The REAP system for rapid retrieval of socio-economic and demographic data became a production system this year, serving the needs of the U.S. Army Corps of Engineers and other governmental agencies. Data files of value to planners are installed in the SEEDIS data base at LBL.. On-line access to these data provides timely information to planners in evaluating the social, economic, and environmental effects of their civil works projects. Numerous enhancements to REAP were implemented this year including multi-user access to a single data base, a facility to permit specification of ranges of geographic areas for data retrieval, indexing of files stored on computer tapes, uniform indexing of all files by FIPS codes, and a help command to assist new users accessing the system interactively. In addition, preliminary specifications were developed for providing access via REAP to 5th count 1970 census data.

Mapping System

The LBL thematic mapping system, CARTE, provides several types of displays based on geographic base files and geographically-coded data. CARTE incorporates a variety of data integration and manipulation facilities to allow the interactive analysis of geographic data by real-time displays of thematic maps. Enhancements completed this year provide the user with several new or improved interactive design capabilities including revising map orientation and titling, specifying the design of crosshatch patterns, identifying binning intervals, performing arithmetic computations on variables, and utilizing point and line display techniques.

Graphic Representation of Tabular Data

CHART, an interactive analysis and display program for tabular data, was converted to run on a minicomputer, and several new features were implemented. People generally have trouble assimilating even small amounts of data in tabular format. Hence, familiar graphic representations such as those found in newspapers, magazines, and technical journals are frequently helpful. CHART uses a vocabulary of basic forms - lines, bars, pies, shading - which may be successively modified until a satisfactory picture is obtained. Manipulations that may be performed include table reorganization - for example, ranking on the basis of a particular row or column, data calibration and selection, scaling and binning, selecing graphic variables, and display annotation and embellishment.

Limited data analysis capability is also provided. Raw data may be systematically transformed into profiles by comparing rows or columns with a standard reference. Change, or percent change, from the reference allows objects to be compared across attributes when raw data values cannot be compared directly.

MATBOARD, developed in parallel with CHART, is a prototype program which has been designed in order to study the feasibility of integrating data analysis techniques with graphic formats to aid decision makers. One particular class of graphic displays (Matrix display) and one type of data analysis (dimensional scaling) are integrated with MATBOARD to offer an aid for two different cognitive tasks - ordering and clustering rows and/or columns of a data matrix.

SEEDIS Monitor

The SEEDIS Monitor was developed as an executive system to ease the problems of job control for interactive users of SEEDIS subsystems and to provide a user-friendly interface to system resources. Through the SEEDIS Monitor, users may access several data management, analysis, and display modules, as well as file management, mail, on-line help, and user-feedback facilities. Users issue simple one-line commands with a few options. Prompting is used to facilitate interactive control and reduce the burden of remembering long sequences of parameters. Using the Monitor, users may now access more than one SEEDIS module within a single job or computer session.

The nature of the Monitor, with its avoidance of a complex job control language, allows the non-computer user to devote time and effort to learning and experimentation with the SEEDIS systems. The learning process has been simplifiied dramatically with the added benefit that the user's project can now be completed within more realistic time frames.

Training In The Use Of SEEDIS Interavtive Systems

With the development of the SEEDIS interactive data retrieval and analysis systems, the need for an educational program arose. This program has progressed along five fronts. The first is a set of users' guides for each SEEDIS system created by the individual system designer. These users' guides describe in detail the capabilities and, to a varying degree, the usage to which each system can be put.

Second, a set of workbooks is being prepared to take up where the users' guides leave off and provide step-by-step examples of the system. These workbooks are directed toward the non-computer user who wishes to apply the system to his particular application but feels the need for cookbook-like instructions at the onset. Three systems now have workbooks: SEEDIS Monitor, CHART, and CARTE.

Third, a full-time consultant is available at LBL, either by telephone or through computer terminal-to-terminal communication, to help the user from the beginning, starting with equipment familiarization and log-in procedure, to data storage and access.

Fourth, copies of each users' interaction with the SEEDIS system via the SEEDIS Monitor are made and routed to the system designers and to the consultant on a daily basis. In this way a user having difficulties is spotted and help is offered, often before the user realizes what his problem is. The SEEDIS Monitor also provides a method for the user to enter comments into the session record to be seen by the system designers.

Fifth, week-long training sessions are held at the Laboratory. At this time, the user is given comprehensive training in those systems for which he has applications and interests as well as a cursory look at those for which he may not have a present need. As the systems continue to evolve, follow-up training sessions may be available.

National Technical Information Service (NTIS)

An interagency agreement between the Department of Energy (DOE) and the NTIS provides government agencies, affiliates and grantees of those agencies, and the public with access through NTIS to SEEDIS data bases, data, and retrieval and display programs. Currently, a series of manpower reports developed under the sponsorship of the Department of Labor are available through NTIS for user-specified geographic areas. Users may also request special analyses which might require unique structuring of data within SEEDIS or data not available in a standard format.

DOE Participation On The Federal Agency Council On The 1980 Census

Initial contacts were made with the chairman of the Federal Agency Council on the 1980 Census with regard to DOE participation in defining the scope and use of this important data source. LBL, because of its extensive experience with the 1970 census, is serving as staff support in coordinating DOE input to the Federal Agency Council on the 1980 census, its working committees, and other pertinent census organizations. Composed of approximately 90 Federal agencies, the Council provides an organizational channel through which federal agencies making extensive use of decennial census materials can transmit advice to the Office of Management and Budget and the Census Bureau. The Council's efforts focus on broad aspects of the 1980 census, including proposals for new questions, major changes in procedures or samples, and tabulation and publication plans.

Contacts have also been established with other appropriate organizations. Interactions with the Bureau of the Census have focused on determining relative priorities in the proposed summary tabulations and the methods and timetables by which data will be released. LBL was officially registered as a Census Summary Tape Processing Center. As such, LBL is kept informed of Census Bureau activities through the monthly Data-Use-News. As in the past, LBL continues to respond to a considerable number of requests for information about census and census-related data.

Problem Areas

The most serious problem which faces SEEDIS is the series of historical accidents which caused each subsystem to be implemented as an independent entity. The result is that no subsystem was designed to speak to any other subsystem and today we are involved in a massive effort to design and implement these communication interfaces after the fact. Two causes for this are evident and I do not know which was the most crucial. First, the various subsystems were independently sponsored and independently used. This situation, combined with the lack of a good, strong data management system at the time, removed most of the incentive to adopt a standard, and also did not provide a standard to use. Second, the massive size and unique structure of the data bases required a special purpose implementation. With smaller data bases and a better data management system, we would almost certainly have used the data management system and we would not be in such trouble now. However, this problem is gradually being solved and we can look at some other problems:

1. The high cost of data base installation;

2. The high cost of user education and "hand-holding";

3. Problems of data integration; ensuring compatibility of time scales, units, coverage and so forth.

We have no good solutions to these problems, but we are trying to prepare a "cookbook" for data base installation, although it seems that every data base is different. Problems 2 and 3 are just plain expensive.

More useful to newcomers is the category of "what I would have done differently". One would have been to analyze the data bases as they were installed and divide them into high-use and low-use portions, so that the average user wouldn't be dragging around the low-use data every time he wants a number. This would be done, partitioning the data bases into smaller chunks, with these chunks managed by the operating system or by a data base directory. The second would be to make more use of data compression techniques and I would even reorganize the data occasionally to provide better compression. This would, of course, take advantage of the fact that most of our data is numeric.

Prospects For The Future

Minicomputers will solve many of our problems by providing for easier acquisition through single-program funding and justification, modular expansion through complete replication of hardware, and improved response time by improving communication speeds.

Computer networks will be required by the multi-minicomputer systems cited above and network capabilities will enlarge the scope of data access to anyone who wishes to connect to the network. The network capability may help the update problem by requiring fewer copies of data bases.

New storage technologies are on the horizon. The most exciting technology, I think, is the video disk adopted for digital use. It may enable everyone to have his own copy of archival data bases, like the Census, for $100 to $1000.

If every citizen gets a home computer which accepts these video storage units, it may finally force the government agencies which collect data to dispense it in a digestible form. Then we can get down to planning instead of spending half our time just digesting.

COVIRS

Dennis M. O'Connor

The development of COVIRS (Classified and Organized Verbal Information Retrieval System) resulted from two earlier activities in the Ocean and Coastal Law Program at the University of Miami. The difficulty of ordering the diverse case decisions in the field of coastal law led to the OLGOP program in 1970-71, which provided for the classification and limited abstracts of cases. Next in 1971-72 a project with NASA support evaluated existing information retrieval systems for handling law/economics information, and produced recommendations for verbal information retrieval systems for environmental data management. The report, entitled "Information Management for Environmental Decisions", made recommendations for the handling of decisional data (legislative, judicial, administrative, executive policy statements, and treaties), journal information (from economic, social science, natural science and law journals), report data and information (including pertinent news media sources).

Given the state of the art of information retrieval in 1972 (and considering likely developments in the forseeable future) the major conclusion--to develop a classified system of reports with specific abstracts of about 250 words or less--was dictated by two major problems: 1) the costs of getting material into machine-readable form; and 2) the costs of string manipulation of data if a full-text system were used. It was recommended that the system be:

- User oriented, so that the demands and responses of users are taken into account in building and modifying the system;

- Designed with a comprehensive and systematic framework, so that new developments in law and science data can easily be located within the system;

- A flexible system, which has the capacity to take new sources of data, in varying formats, and integrate them with relatively minor changes;

- A classified and abstracted system. Use of full-text sources may have value only in certain specialized areas where the source materials are relatively homogenous and within a limited series, and where user demand may justify the cost (such as a treaty series, or the statutes and case law of a particular jurisdiction when the demands of lawyers and other users match the costs).

• The classification vocabulary should be designed to fit the total question space; When a list or outline form is used, a residual category named "other" can achieve the goal of comprehensive coverage while its contents are periodically reclassified as knowledge is gained;

• Classification of records into the system is assigned by trained persons acting as analysts and filters. Comparability is achieved without the assigned classifier or keyword necessarily appearing in the text of the data source;

• Abstracts which are highly specific offer further information to a user before he seeks the original data source. And such abstracts offer a good chance for refinement of the classification system without having to rework the original data sources;

• A tiered and multifaceted index or keyword system, in which each record is classified by descriptors which indicate the environmental features to which the record pertains, and the uses of the environment, and decision policies (where applicable) as well as time and place, economic, social science, natural science, and other elements of the record;

• A thesaurus entry system, which includes the construction of a thesaurus or thesauri for purposes of interrelating the classifications and interfacing the various relevant disciplines;

• A system in which the manipulated data records are of moderate size, perhaps 500 to 2000 characters. Specific details and pointers (such as citations) in the record can lead the user to the source document or additional data. The costs, given the present state of the art, of producing machine-readable entries and of computer operation are a major reason for the choice of a condensed record for purposes of computer manipulation. Source documents can be maintained in a low cost storage portion of the system in cases where they are not otherwise available and the demand for them is sufficient;

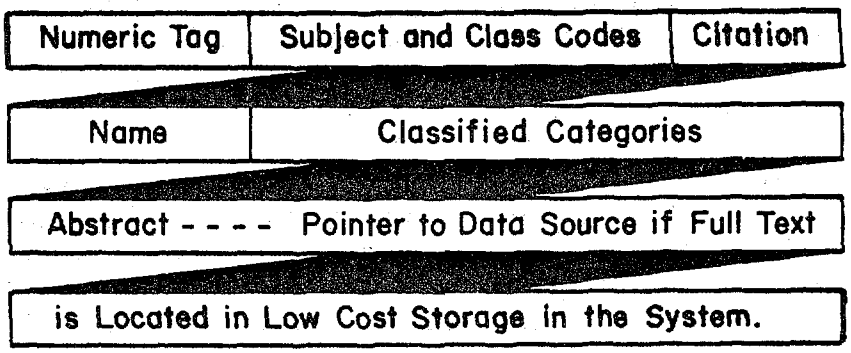
• A system using a variety of sources for the generation of records. Decisional materials, journal information, reports from various disciplines, and even news articles should be included;

• A system which emphasizes products which are "reasonably useful." Given the need for coordinated data from law and the sciences pertaining to the environment today, even the fabrication of synthetic products from complexes of presently available data can be important.

● **A system which generates a variety of products, including periodic published reports, selected dissemination of information to subscribers, and terminal access;**

During the NASA project and subsequently by collaboration of several specialists in 1972-74 the COVIRS system was developed. It has the capacity of meeting the recommendations of the "Information Management for Environmental Decisions" report, and is operational. However, due to lack of specific funding (and a decision not to market it) it has had only occasional use in handling the coastal law cases and journal articles which comprise the data base being used in the Ocean and Coastal Law Program.

COVIRS records are of about 2,000 characters in length, and are in general form:



A thesaurus of the user's choice is employed for the classification of records. And it may be varied at will. (Keywords may be of 3 to 7 characters, and up to 18 keywords may be assigned to each record.) Thus, a tiered and multifaceted system of classification may be used. And the user can retrieve by selection of any or several of them, or by asking for a report in outline format (with headings on each page to indicate the tiers in his classification system where the information is located). The report outline (and the selection of records in the system which will be included in the report) may be chosen by the user. The number of keywords, of 3 to 7 characters, which may be used is practically unlimited. And users can classify according to environmental features, time and place, uses, resources, policy issues or terms, or any other criterion.

Different subjects can also be indicated, by a two-letter subject code, for over 600 subjects in a master file. When a user selects a subject code for retrieval and further selection, the program scans for the requested subject code and saves search time. Or, retrieval can be by number, name, citation (or portion thereof), or by selected words in the abstract (3 to 15 characters).

Abstracts of up to 20 lines of 72 characters each may be included in the records. Over 50,000 records can be stored on a standard 2400 foot reel of tape. Update of a record, or any line in it, can be done conveniently.

Seven different citation forms are available for input: case (judicial and administrative), statute (including regulations, ordinances, treaties, etc.), periodical, magazine, book, newspaper, and directory (of persons, organizations, etc.)

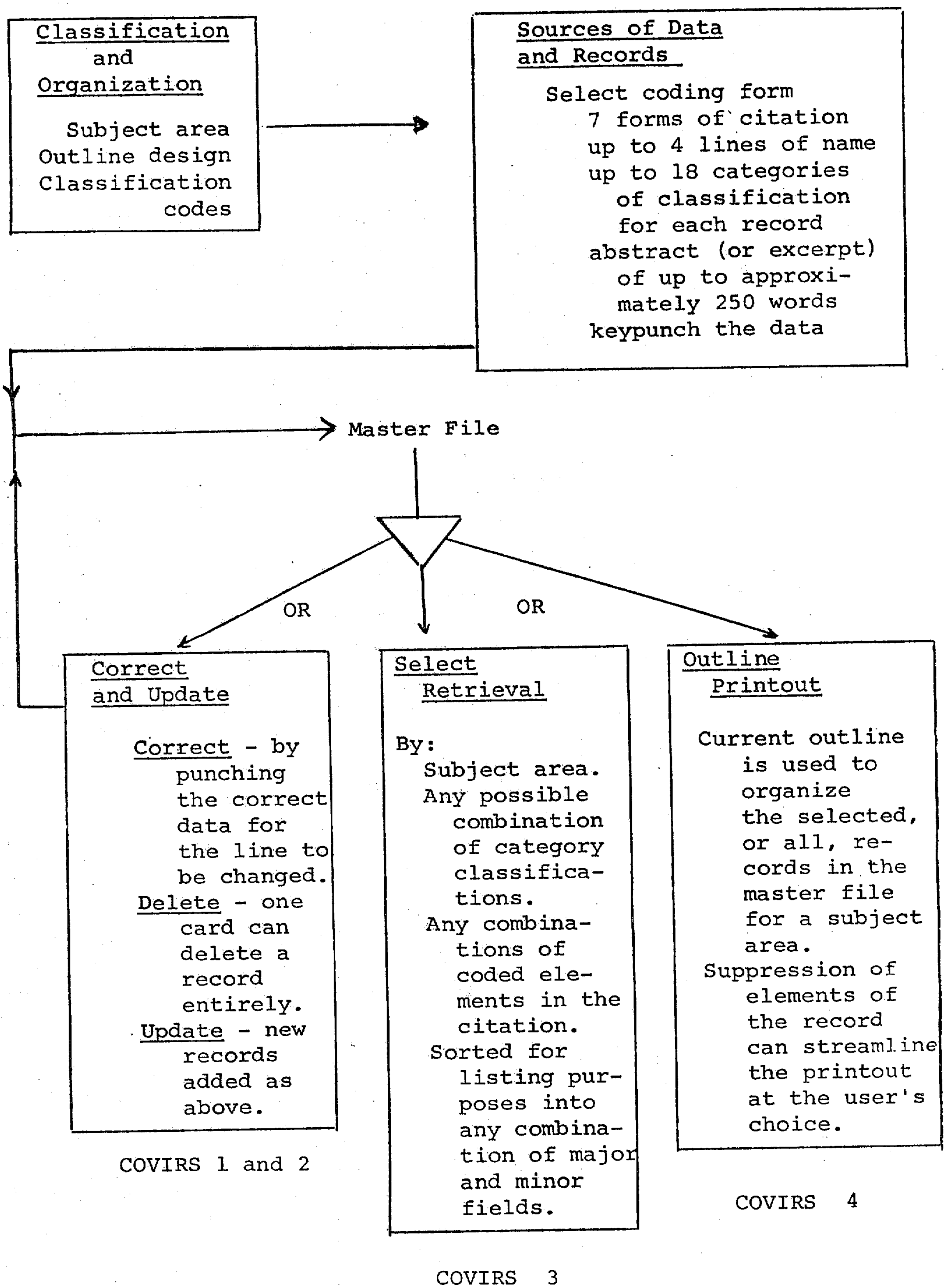
Subjects, classifications, citation forms are all compatible in a master file. They can be put in in any order, and selected by any specific type, and in printouts can be requested in any desired sequence. All Florida cases may be selected and printed in chronological order, for example, of all records pertaining to Florida, of whatever input type, can be selected and printed in chronological order. Or the entire directory of persons (from whatever state) may be selected, sorted according to zip-code order, and printed (without classification, and without abstracts) on mailing labels. Sorting of the selected records can be done according to any of the information contained in the citation or category portions of the records, or any combination of the criteria in these portions of the records.

The most useful type of information product from a master file is an organized, or outline, listing (with page headings) at the option of the user. Within a subject area (or all the subjects in the master file) an outline is prepared by the user. This outline may be varied from time to time. An outline may have up to 999 headings and subheadings, grouped in outline format with up to 9 levels of subordination or indentation. This capacity is much larger than would be required in practice, for an outline of more than 200 headings, and with more than 5 levels of subordination within a major heading, is rare.

The four basic programs in COVIRS are:

- -COVIRS 1 <u>The System Update Program</u>. Enters record data, and assigns sequential serial numbers to new records.
- -COVIRS 2 <u>The System List Program</u>. Lists, in expanded format, as is appropriate to the citation form, all records in an update or in the master file.
- -COVIRS 3 <u>The System Select Program</u>. Selects records from the master file according to designated criteria of: subject area, classification categories (or any combination thereof), and elements of the citation (or any combination thereof), and sorts the selected records according to any desired criteria.
- -COVIRS 4 <u>The System Outline Print Program</u>. Using an outline with headings as provided by the user, this program prints the selected records (sorted as requested) with the outline heading and superior heading listed at the top of each page. Portions of the records may be suppressed to streamline the printout.

COVIRS system summary:



The National Sea Grant Depository

Betty M. Edel, Librarian/Manager

The National Sea Grant Depository (NSGD) is an information and documentation center established by the Office of Sea Grant in 1971 at the University of Rhode Island's Pell Marine Science Library. Its main objective is to ensure that all publications generated by the National Sea Grant Program would be available in a single location for loan and archival purposes. It is the only collection of its kind which extends borrowing privileges throughout the world.

The collection consists primarily of reprints, technical reports, marine advisory reports, and analytics from conference proceedings. These publications touch on a wide variety of subjects including such areas as coastal management, aquaculture, fisheries, pollution, eco-system research, law and socio-economics, ocean engineering, etc.

From the beginning, it was seen as a necessity to have some sort of computerized bibliographic control on the publications that would be housed in the Depository. A system was developed by Depository staff using the facilities of the Academic Computer Center at the University of Rhode Island. The result was a bibliographic data base created to store the citations for the Sea Grant generated publications. By the end of 1977, the cumulative data base had more than 12,000 entries with approximately 2,000 entries being added per year. Although the system was developed for a special purpose, its construction is quite general and modular and hence it has found several uses other than that for which it was originally written.

There are several different data bases in this system. Each data base has a specific purpose and has specific programs associated with it. Each data base in the system is made up of one or more files (Containing information for a specific period of time) all of which have the same format and which can logically be thought of as one file.

The Bibliographic Data Base (BDB) is the main data base in the system. It contains all of the information on each document in the collection. Information is entered into the BDB through a remote terminal. Once entered into the BDB, the information remains there indefinitely and may be accessed by any of the programs in the system.

For the public to access this extensive volume of material, NSGD publishes an annual index and monthly acquisitions lists. The annual index contains an average of six access points for each bibliographic entry. In the index, the user will find:

1. A document listing or bibliography of Sea Grant publications in alphanumeric order by Depository assigned document numbers;

2. A KWIC (key-word-in-context) or subject index using key words from the title of the document;

3. An author index;

4. A corporate body index;

5. An index of National Technical Information Service (NTIS) numbers assigned to the publications; and

6. An index of any other numbers identifying a given document.

For researchers, management, librarians, or other interested individuals, who need more timely up-to-date bibliographic information, the convenient monthly acquisitions list is a helpful resource. This is a listing by document number, title and author. Its size is determined by the number of publications received each month by the Depository.

To fully utilize the cumulative base, packaged literature searches are available. These searches are a direct result of numerous requests on specific topics. Included in each packaged literature search are a document listing, KWIC (subject) and author index.

The primary purpose of NSGD is to provide services through various means including:

1. Quick and efficient access to all Sea Grant funded publications.

2. Direct or Inter-library loan of all publications in the collection.

3. The yearly Sea Grant Publications Index.

4. The monthly Sea Grant Acquisitions List.

5. Packaged Literature Searches on select topics.

6. On-site use of the collection.

All activities and services provided by NSGD are made possible through a grant from the Office of Sea Grant, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Any and all questions or requests should be directed to:

NATIONAL SEA GRANT DEPOSITORY
Pell Library - Bay Campus
University of Rhode Island
Narragansett, RI 02882

Informational Needs of the Coastal Energy

Dan Hoydysh*
Chief, Information Branch
Coastal Energy Impact Program

The Coastal Energy Impact Program (CEIP) was established by the Coastal Zone Management Act Amendments of 1976. The purpose was to provide Federal financial assistance to coastal states which would be used to mitigate adverse impacts in the coastal zone of energy development activity. An underlying assumption of the CEIP is that it is in the national interest to encourage rational and timely development of domestic, coastal energy resources and the means for transporting these resources from one region to another. But, this development must take place with a maximum concern for the fragile coastal environment.

To this end, the CEIP provides 3 basic types of assistance. There are grants for studying and planning for the social, economic, and environmental impacts of this type of energy activity. There are grants for preventing damage to valuable coastal environmental and recreational resources. Additionally, there are loans to provide public services and public facilities in those areas that are adversely affected by coastal energy development.

The CEIP is authorized at a level of 1.2 billion dollars, over 10 years. Roughly divided--and there is some simplification here--it works out like this. There are 50 million dollars for planning grants, 750 million dollars for loans, and 400 million dollars for formula grants. That's something that I will explain later. For the two fiscal years that we've been operating, there has been appropriated approximately--well, now, exactly--700 million for planning, and, approximately, 30 million for formula grants, and approximately 200 million for loans.

There are at least three levels at which information is needed to properly implement a program such as the CEIP. There is the first level, which is the congressional policy level, the point at which to question whether to create such a program in the first place and to question for how much to authorize the program. The second level is the administrative implementation level, at which the questions dealth with are: How to structure the program; decide the priority; select the staff; and decide how much to request in appropriations. A third level is the technical operational level which is how, in practice, to accomplish the stated ends of the program.

I will outline some of the decisions that were made, the information required, and the systems used to satisfy this need. My primary responsibility with the CEIP is to supervise the distribution among coastal states of funds appropriated in the fiscal year for CEIP purposes. While the information grant is also responsible for preparing budget requests, the ultimate decision here is outside our hands and, therefore, I will start at a point

*This information was presented at COMS Second Annual Conference.

where the CEIP budget is already approved. Comment has been made that the Act was being inefficiently administered, in the sense of getting money to where it was needed at the right time, but I suggest that some of this, if it is true--and, I do not concede that it is--may be due to the rigidity of the statute itself. This problem will become obvious from my discussion.

The method of distributing, among coastal states, grants to prevent, or reduce, damage to valuable coastal recreational and environmental resources, is expressly mandated by the statute by means of a specific formula, hence, the term formula grants. The formula, as specified in the statute, contains 4 components; one third of the allotment to a state is based on new acres leased adjacent to that state; one sixth is based on oil and gas produced off the coast; one sixth is oil and gas first landed; one third is a factor for new employment. This money is targeted for those states facing OCS development so there is not much discretion within which the administrator can administer since the only term that even remotely lends itself to any result-oriented manipulation is new employment, affecting only one third of the formula. The information needs here are satisfied fairly simply through queries of USGS and the petroleum industry on acres leased, oil and gas landed, and oil and gas produced. We do have extensive contacts with industry to try to define, or try to quantify how much new employment is due to OCS activity.

Another question is why use such a formula at all, to which I do not have the answer, but can raise some of the issues, as we see them. The CEIP is based on providing funds to those areas that need the funds and for a state like Alaska any OCS activity off Alaska would impact only Alaska. In this case the formula makes a great deal of sense, whereas for New England, it becomes more difficult to determine the impact on individual states based on acreage leased, particularly when that OCS activity is not offshore the states impacted by the other factors in the formula. This leads to the situation that the formula will not adequately reflect a state's needs all of the time.

The second category of funds is the loan program and here again the administrative flexibility is reduced by the statute which requires that funds appropriated for loans be alloted based on the formula. The two factors are standardized unit costs, and the number of additional individuals who are expected to become employed in new coastal energy activity.

Having a very specific definition of OCS activity, transportation of coal, oil, or liquified natural gas, we came up with a formula which requires that we find out what the standardized unit costs are for providing public services and building public facilities for which the loans are to be used. We have to project new employment related to new coastal energy activity. How many people will be employed? How many people will be moving into the coastal communities? How many will bring their families? What size families? This is all information that we obtain from the Census Bureau and the IRS, through income tax returns and, we make some assumptions, to try to come up with a rational relationship of money to need.

Another problem inherent in the statute, in matching needs with funds, is that although you allocate money based on the level of new activity, the state is allowed to spend the money to remedy past efforts, or impacts and there is not always a correlation between new activity and the damage that is being rectified.

The third category of funds is planning grants, for which no guidance is given, except to state that the Secretary shall make grants to study and plan for social, environmental, economic impacts in the coastal zones.

The two basic approaches that one can use to distribute these funds are to allot by a formula, or to rely on applications for grants and since the theory of the statute was allotment by formula, based on need, we tried to follow this route. As one of the basic goals of the Coastal Zone Management Act is to encourage state participation in the coastal zone management program, we took that principle and applied it to the CEIP. That led us to the idea of providing a minimum level of assistance for each state, so that each state would, regardless of whatever calculations we made have at least a minimum amount of money to participate in the program.

We took 15 percent of the funds and divided it up among the states, which comes to about $16,000 per state. The remaining 85 percent is alloted by formula among the states based on a need computation. To compute relative need among the states we produce an inventory of all new energy activity in the coastal zone.

Once we've identified all the new energy activity, we then try to compute a planning need factor for each new, or expanded, facility, and these needs are summed for each state resulting in that state getting a proportion of the 85 percent remaining.

INFORMATION: FAST OR FANCY

Michele Tetley
Outer Continental Shelf Referral Center
U.S. Department of the Interior

The term information can be a misleading one because everyone has a different concept of what information is. Most people only consider written materials to be information and yet, in my experience, particularly in the coastal management field, the most valuable and certainly the most sought after information has been verbal.

Over the years, I have been repeatedly asked to identify and quantify the information needs of whatever constituency I was serving at the time, but it is nearly impossible, particularly at the national level, where one has a multitude of states and a mixture of public and private interest groups to respond to. Add to that the factor that the user audience has a wide range of expertise and that in the fast moving field of coastal and marine resources, new issues can create beginners out of experts, on a particular subject. This results in rapidly changing information needs over time for some subject areas and an inherent difficulty in predicting information needs over a long period of time, since a single piece of State of Federal legislation can alter your information requirements overnight.

For the most part, any user approaching an information service has only his, or her, particular question in mind. And, if a specific answer, tailored to that particular problem, isn't available, the user often questions the usefulness of the system. This assessment ignores the fact that most general information systems are designed to serve hundreds, or thousands, of individuals on a wide range of topics and seldom are two questions alike, since everyone uses information differently. The comprehensiveness of these information needs does, however, mean that the coastal decision-makers will never be able to look to a single information or data base to answer their questions. Indeed, it would be fruitless for us to try to develop one as what is called for is greater ingenuity on the part of the user and increased reliance on information locator services.

Ten years ago, my first information effort was to develop a comprehensive, coordinated, joint-planning library for the land and water resources of the Great Lakes Basin. Faced with this dilemma of a vaguely outlined problem, I decided to let the information center design itself around the needs articulated by the Great Lakes' planners. I quickly learned that people were a much better source of current information than were books and that there were a lot of small subject-specific information collections in the region, known only to a small number of researchers.

I brought that philosophy with me when I came to the Office of Coastal Zone Management (OCZM) to develop a coastal zone information center, over five years ago. Once again, there was a paucity of literature on the subject but this time the information and expertise on the component parts of CZM were scattered throughout the country. The task was to link them together, using an approach that the information community began to call networking.

I have currently embarked on another information effort. Several months ago, the Outer Continental Shelf Program Coordination Office (OCS), within the Department of the Interior, hired me to establish an OCS Referral Center which was initially requested by the coastal state representatives of the OCS Advisory Board, and subsequently requested in the President's 1977 environmental message. It was created to provide coastal state and local planners, and the public, with improved access to outer continental shelf data and information. The OCS Referral Center will serve primarily as a switching station, and I am in the process of familiarizing myself with the various OCS issues and individuals who handle the component parts of this extremely complex operation.

Initially, I am concentrating on the Department of the Interior but I will also be establishing contacts within the other Federal agencies, the oil and gas industry, and State governments. On January 27, 1978, the U.S. Geological Survey and the Bureau of Land Management (BLM) published regulations on oil and gas information programs and, in time, the summary reports and the indices called for in these regulations should provide us all with a better understanding of the activities on the outer continental shelf. There is a wealth of information and data existing on the OCS matters; however, it is scattered among agencies, offices, and individuals. It is very easy to end up empty-handed and frustrated if you are not familiar with the proper person to call and how to ask for that information which you seek. This information location problem exists not only at the state and local levels, but at the Federal level as well.

Still another information effort designed to aid planners and the public could be called, in current terminology, coastal cloning. It is an attempt to replicate regionally the types of information services provided through the coastal zone information center, Environmental Data Service (EDS), NOAA, and the OCS Referral Center in the Department of the Interior. Two years ago, three NOAA offices, OCZM, Sea Grant, and EDS combined their resources to establish a system of regional coastal information centers (RCIC) operated through Sea Grant's Marine Advisory Service. These information centers are designed to provide a regional specificity that cannot be accomplished at the national level. While linked to the national programs, they can tap the considerable data resources at that level and, ultimately, should provide an invaluable, interlocking, regional information network. Currently, three are in existence: In the Pacific Northwest; in the Great Lakes; and for New England, the original one is operating here at URI. These centers are information locators, facilitating the communication and transfer of pertinent coastal and marine information throughout the coastal community.

Fast-turnaround information services of the type that I have provided over the years depend heavily on the more formal, library collections, archives, data banks, and other fancy, but ponderous, information systems. Their complexity, and specificity is necessary to capture and retrieve the vast amounts of data our society generates on any given topic. Their very structured format, however, precludes responding speedily to new issues and developments. While these systems are valuable for in-depth research in established subject areas, they are no use at all in current awareness. It is important, therefore, for the information user to know what to expect and what not to expect from any given information system. Some are informal and, therefore, nore flexible and responsive to new and ever-changing needs, while others, more structured and less flexible, also play a valuable, but more specialized role. Most information needs require a combination of the two, an information mix of people, documents, and data.

Periodically, there are recommendations to create gigantic data bases, or collections, which could supposedly, answer all questions on a discipline. I suggest that time and money is better spent identifying and utilizing the resources where they presently exist, as communication and cooperation between individuals and institutions creates useful, yet inexpensive information linkages.

I will admit that any of our individual information systems are far from ideal. I think this is, perhaps, not the fault of the system, so much as the user. Asking any system to do something it was not designed to do, creates problems. A lot of new services have been created in the past few years in response to state and coastal planning needs. Now, it's the information user's responsibility to learn to utilize them.

Appendix

List of Participants

Cheryl Alexander

ESIC/EDS/NOAA D8
Rockwall Building
Rockville, MD 20852

Provided impetus for Regional Coastal Information Center Program. Authored "State of the Art on Networking of Information Activities Relating to Coastal Management" and "Preliminary Proposal to What a National Coastal Resource Center Information System Might Look Like."

James Aichele

South Carolina Coastal Council
4 Carriage Lane, Suite 205
Charleston, SC 29407

Designed graphics system and digitized manual system of overlays, which uses 7.5 minute topographic maps with overlays for wetlands, impoundment areas, beach zones, bottom type which includes densities for shellfish, lease areas.

John Buffington

Council on Environmental Quality
Washington, DC

Project Officer for UPGRADE, a system for analyzing computerized data on the environment, natural resources, and public health.

Janet Campbell

Marine and Application Technology Division
MF 270
NASA Langley Research Center
Hampton, VA 23665

Experienced in remote sensing of marine environment. Currently participating in project to compile information on remote sensing application in coastal zone.

Peter Cornillon

Department of Ocean Engineering, Assistant Professor
Bliss Hall
University of Rhode Island
Kingston, RI 02881

Experienced in data processing, remote sensing, oil spill assessment and predictive modelling, and interfacing. On COMS Steering Committee and is currently involved in developing computerized information system for Rhode Island coastal managers.

Charlene Quinn Dunn

Coastal Information
Northeast Regional Coastal Information Center
URI-MAS, Bay Campus
Narragansett, RI 02882

Coordinator of Northeast Regional Coastal Information Center

Betty Edel

National Sea Grant Depository
Claiborne Pell Library
URI Bay Campus
Narragansett, RI 02882

Manager and Principal Investigator for the National Sea Grant Depository, which has a 12,000 entry computerized bibliographic data base. Experienced with NSGD system as well as other on-line networking systems. Compiler of the 1977 Sea Grant Publications Index.

Robert E. Freeman

Deputy Director
Environmental Science Information Center, D8
U.S. Department of Commerce/NOAA
Rockville, MD 20852

Has worked with information center management, data base management, computerized information retrieval systems, information systems management, information networks, and environmental and natural resources information for twenty years. Since 1968, he has held successively the positions of Technical Information Specialist, Chief of Scientific Information Systems Branch, Chief of Technical Information Division, and is now Deputy Director of the Environmental Science Information Center.

Ernest Hardy

Resource Information Lab
Cornell University
Box 22, Roberts Hall
Ithaca, NY 14853

Developed Resource Information Laboratory. Helped develop the New York State Land Use and Natural Resources Inventory, which contains 135 land use and point information types derived from air photo interpretation and field reconnaissance.

Harvard Holmes

Computer Science and Applied Math Group
Lawrence Berkeley Lab
Berkeley, CA 94701

Computer Graphic Specialist. Worked on CARTE System used for Urban Atlas series of colored maps. Presently in charge of the Social Environmental Economic Demographic Information System (SEEDIS), which includes numerous data bases and retrieval programs that are interfaced to graphic display programs.

Robert Holton

Northwest Coastal Information Center
School of Oceanography
Corvallis, OR 97331

Coordinator of Northwest Regional Coastal Information Center.

Dan Hoydysh

Coastal Energy Impact Program
Office of Coastal Zone Management
Washington, DC

Current Chief of Data Information System for Coastal Energy Impact Program. Developed Coastal Energy Information System which is the first complete inventory of the new energy facilities in the coastal zones of the 30 coastal states and four U.S. territories.

Nancy Huang

Great Lakes Basin Commission
3475 Plymouth Road
P.O. Box 999
Ann Arbor, MI 48106

Currently Informations Specialist for Great Lakes Regional Information Referral Center. Worked in the Highway Safety Research Library and Information Center at the University of Michigan. An initial consultant for the Women's Education Equity Communications Network, which started a network of women's information services.

Connie L. Knapp

Department of Geography and Marine Affairs
University of Rhode Island
Kingston, RI 02881

Completing Master's thesis on information systems for coastal resources Management. Also completing one component of a computerized tool for coastal management in Rhode Island- a system which assesses and analyzes permit application information.

Dennis O'Connor

Professor of Law and Director of Ocean and Coastal Law Program
University of Miami
Coral Gables, FL 33124

Experienced in information retrieval systems and improved methodologies and advances in the state of the art for Law/Economics in environmental data management.

Stephen Olsen

Coastal Resources Center
URI Bay Campus
Narragansett, RI 02882

Working on Coastal Zone Information System for Rhode Island.

John B. Pleasants

Virginia Institute of Marine Science
Gloucester Point, VA 23062

Developed the Marine Environment and Resources Research and Management System (MERRMS) for state of Virginia. The system features a comprehensive cartographic data base for the Chesapeake Bay region, a heavily indexed library with publications stored on microfiche and computer-retrieval, and a multi-projector visual display system.

Cary C. Rea

Department of Environmental Sciences
University of Virginia
Charlottesville, VA 22903

Investigator for the University fo Virginea Coastal Information System (UVAIS), a carefully catalogued data referral system geared toward the coastal environment. Research precipitated a general review of naval data management as well.

Alan Robinette

Minnesota Planning Agency Information Center
Capitol Square Building
St. Paul, MN 55101

Computerized the following for state coastal management program: 40 acre or 2.5 acre maps created by computer-derived map as overlay on hand-drawn base.

Jens Sorenson

Sea Grant
University of California
Berkeley, CA 94720

Directly involved in proposal for California Regional Coastal Information Center.

Malcolm Spaulding

Associate Professor
Dapartment of Engineering
University of Rhode Island
Kingston, RI 02881

Responsible for the development and application of numerical models to coastal processes. Currently the principle investigator of a project to develop an interactive interface between existing computer models of coastal dynamics and the coastal managers of Rhode Island. Also experienced in ocean instrumentation and pollution analysis.

Donald B. Straus

President, Research Institute
American Arbitration Association
140 West 51 Street
New York, NY 10020

Environmental mediation techniques modified in development of new problem-solving processes called "data mediation" and "data validation", which are useful in information system development as well as in resolving environmental disputes. Experience in facilitating man-computer interaction in addition to communcation among differing parties.

John Sun

Resource and Land Investigation Program
U.S. Geological Survey
Reston, VA 22070

Computer specialist for RALI Program.

Michele M. Tetley

OCS Referral Center, Room 4130
U.S. Department of the Interior
Washington, DC 20240

Has spent last 10 years setting up information centers in coastal and marine field: 1) Great Lakes Basin Library, 2) Mercury Contamination Information, 3) Coastal Zone Information Center, 4) OCS Referral Center - and initiated the Regional Coastal Information Center Project in NOAA.

Paul Templet

P.O. Box 44245
Capitol Station
Coastal Resources Program
Department of Transportation and Development/State Planning Office
Baton Rouge, LA 70804

Works with IMGRID - system for determining capability/suitability of coastal sites for various uses. It is a computerized system with 32 variables under three broad catagories: physical, biological, and sociological.

Virginia K. Tippie

Executive Director
Center for Ocean Management Studies
University of Rhode Island
Kingston, RI 02881

Worked with Rhode Island's Coastal Zone Management Program. Present responsibilities include include identification of data needs for coastal and ocean management, and development of a conceptual framework for management of the marine environment.

Neils West

Department of Geography and Marine Affairs
Washburn Hall
University of Rhode Island
Kingston, RI 02881

Interest lies in Environmental Impact and Assessment Process. Had done a great deal of environmental consulting. Uses computer graphics for academic and consulting purposes. Works with low-level air photo and low-level geographical spacial information systems.

Carl E. Youngman

Director, Cartographic Laboratory
Department of Geography
University of Washington
Seattle, WA 98195

Designed automated environmental information system for state of Washington. Currently developing a Coastal Zone Atlas of Washington State using environmental information system as data base and computer-assisted cartography, which allows a variety of computer analyses.